OFFSHORE TECHNOLOGY

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SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

OF THE

COMMITTEE ON MERCHANT MARINE AND FISHERIES HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

SECOND SESSION

ON

THE STATE OF RESEARCH AND DEVELOPMENT IN OFFSHORE TECHNOLOGY FOR THE OIL AND GAS INDUSTRY

MAY 19, 1994

Serial No. 103–120

Printed for the use of the Committee on Merchant Marine and Fisheries

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OFFSHORE TECHNOLOGY

THURSDAY, MAY 19, 1994

HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF, COMMITTEE ON MERCHANT MARINE AND FISHERIES,

Washington, DC.

The Subcommittee met, pursuant to call, at 1:41 p.m., in room 1334, Longworth House Office Building, Hon. Solomon P. Ortiz [chairman of the Subcommittee] presiding.

Present: Representatives Ortiz, Green, Hughes, and Weldon.

Staff Present: Sue Waldron, Press Secretary; Robert Wharton, Senior Professional Staff; Sheila McCready, Staff Director; John Aguirre, Legislative Clerk; Katie Hornbarger, Judy Wilson, and Mac King, Staff; Richard Russell, Minority Counsel; Dave Whaley, Minority Professional Staff; and Margherita Woods, Minority Chief Clerk.

STATEMENT OF HON. SOLOMON ORTIZ, A U.S. REPRESENTATIVE FROM TEXAS, AND CHAIRMAN, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

Mr. ORTIZ. The Subcommittee will come to order. I hope by the time I finish my opening statement, the Ranking Member will be here; he is on his way and we are just waiting for him.

Good afternoon, I would like to welcome all of you here today on behalf of the Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf.

Today the Subcommittee meets for an oversight hearing on the state of research and development in offshore technology for the oil and gas industry. The successful transition of the oil and gas industry from onshore areas to offshore areas earlier this century was a direct result of rapidly advancing technology. During the 1950's, key technologies included many new offshore platform and vessel designs. In the 1960's, we saw the introduction of well blowout preventers, robotics, and semisubmersible drilling platforms. As the industry progressed further offshore in search of new reserves, advances in platform design, seismic data collection, and computer technology kept the industry viable.

However, as of 1980, the size of new discoveries in the Gulf of Mexico began to shrink and with falling oil prices, industry began scaling back existing operations and looking farther offshore into deeper waters and areas overseas. As a result, platform removals

in the Gulf of Mexico exceeded installations for the first time in 1989.

Last year, the Gulf of Mexico regained its importance to the offshore oil and gas industry as a result of new developments in exploration. New technology played a key role in this rejuvenated interest, and will continue to be a key factor in maintaining and revitalizing the domestic oil and gas industry.

With this hearing the Subcommittee continues its review of the Nation's offshore oil and gas program. Last year we heard testimony on deep water and Arctic drilling and production technologies. The purpose of this hearing today is to examine recent developments in technology that will allow more efficient utilization of traditional offshore areas. Currently, technological developments are increasing in the areas of exploration, drilling and development, and a number of new developments are anticipated in the near future. The Subcommittee is interested in learning about the implications of these new technologies on the domestic offshore industry. We are also interested in learning more about the regulatory implications of technological advances. I look forward to hearing from the distinguished group of witnesses that we have assembled before us today, and I want to thank each and every one of you for being with us.

I also know that some members will be coming in later as we move along with the hearing. I would like to introduce their statements for the record as we move along.

Also, all your statements that you have will also be included for the record.

Mr. ORTIZ. I would like now to introduce today's panel consisting of representatives of the Federal Government, industry and academia. All have been involved in the development of new offshore technologies. We will hear first from Mr. Thomas Gernhofer, Associate Director, Offshore Minerals Management of the Minerals Management Service, Department of the Interior.

Mr. Robert Sleet is the Vice President and Treasurer of Global Marine, Incorporated and will be speaking on behalf of the National Ocean Industries Association. Next, Mr. William Jennings, Vice President of Noble Drilling, Incorporated. Mr. Jennings will be speaking on behalf of the International Association of Drilling Contractors. Dr. Michael Champ is the Director of the Washington office of Texas A&M University, Geochemical and Environmental Research Group. And Mr. James Fox is Geoscience Director for Phillips Petroleum Company.

We were just joined by my good friend, Mr. Green, and I yield to him to see if he has an opening statement.

STATEMENT OF HON. GENE GREEN, A U.S. REPRESENTATIVE FROM TEXAS

Mr. GREEN. Thank you, Mr. Chairman. I would like to submit an opening statement, and I appreciate the opportunity to be here and also for the Chairman calling this important hearing today. I will submit my statement.

STATEMENT OF HON. GENE GREEN, A U.S. REPRESENTATIVE FROM TEXAS

Good afternoon. I want to thank Chairman Ortiz for holding this hearing on the state of research and development in offshore technology for the oil and gas industry. Offshore technology will play a major role in the future and stability of the offshore industries.

Technology such as the Three-Dimensional (3D) Seismic Survey lead to the success of Phillip's Mahogany, an oil discovery in the Gulf of Mexico, 80 miles offshore Louisiana. The Mahogany drilled to a total depth of 16,500 feet and 370 feet of water, with the well flowing up to 7,256 barrels of oil per day. This discovery was the first successful well in subsalt play.

Shell Oil has also had success with using the three-dimensional survey. They use it for exploration and development of fields, showing them where to put a platform and how to do plant drilling. Shell has also used three-dimensional surveys on existing fields as well.

I am confident that technology such as this will reduce operating cost and open new opportunities for companies such as Phillip's, Shell, and Exxon, allowing them to stay ahead of the industry. It has been proven that three-dimensional seismic surveys have reduced risk and increased confidence in drilling.

I want to welcome our witnesses and I look forward to hearing their testimony today. Thank you, Mr. Chairman.

STATEMENT OF THOMAS GERNHOFER, ASSOCIATE DIRECTOR, OFFSHORE MINERALS MANAGEMENT, MINERALS MANAGEMENT SERVICE, DEPARTMENT OF THE INTERIOR

Mr. ORTIZ. Thank you. I think we will begin with Mr. Gernhofer.

Mr. GERNHOFER. Thank you. I am the Associate Director for Offshore Minerals Management at the MMS which is the chief regulatory agency of the offshore oil and gas industry.

I would like to begin this afternoon, if I may, by speaking about the Gulf of Mexico. This past March 30 we held OCS Central Gulf Sale 147. That resulted in $277 million in high bids on 375 tracts. To contrast that with the Central Gulf Sale last year, that sale resulted in only $64 million being bid on 187 tracts, so there is a considerable increase in activity in the Gulf.

In fact, it is the world's most active offshore drilling province today. We believe several factors are responsible for this increase. The improved price of natural gas; the improvements that will be discussed here in exploration technology; and the deep water and subsalt frontiers.

To give you some idea, we have permitted 120 exploratory drilling rigs in the Gulf of Mexico as of today, 10 of those operating in depths greater than 1,000 feet.

The technology of 3–D seismic is something that we look forward to in MMS for two main reasons in helping us in fulfilling our regulatory responsibilities. First, the acquisition of 3–D technology will enable us to do a better job of resource evaluation in the future, even as we reduce the number of employees in MMS.

Second, and perhaps more important to the taxpayer, we should be able to do a better bid adequacy review to ensure the taxpayer is receiving fair market value for the Federal lands that we lease to industry.

We take very seriously the mandate in the 1978 OCS Lands Act Amendments that require the Secretary to use best and safest available technology. And in order to carry out that mandate, we have to know what that technology is.

Therefore, since 1975 we have developed what we call the "Technology Assessment and Research Program". It is a catalyst for industry activity. It enables us to keep abreast of technology. It en-

ables us to identify technological gaps, and hopefully it enables us to have a better knowledge base upon which to craft or redraft intelligent regulations.

In addition, the TAR Program, as we call it, is a good deal for the American taxpayer. Because of associations both with industry, other agencies, and even foreign governments, every dollar in taxpayer funds results in $4 of research being performed.

The MMS has conducted any number of workshops in the last several years. I would just like to mention a few of them. We have done workshops on pipeline safety, blowout prevention, the issue of age of platforms, the effects of Hurricane Andrew on the offshore structures, composite materials, seismic concerns, and last, the in situ burning of polluted oil. I would like to spend one minute on that.

Last August off Newfoundland culminated 10 years of effort in a large scale offshore in-situ burn. The preliminary results are very encouraging. We are not currently pursuing any more in-situ burns in the Gulf of Mexico, but we may in the future.

We believe that in the proper place and time, burning in-situ of spilled oil is an appropriate way to reduce environmental damage. In fact the Environmental Protection Agency has just recently given permission to its onscene coordinator in the Gulf of Mexico to use this technology in the event of an actual spill if that onscene coordinator feels it is appropriate.

With that, Mr. Chairman, I will be glad to answer any questions that you may have later on.

Mr. ORTIZ. Thank you. We will just wait before we go through the entire panel and then we can ask questions.

[The statement of Thomas Gernhofer can be found at the end of the hearing.]

STATEMENT OF ROBERT E. SLEET, JR., VICE PRESIDENT AND TREASURER, GLOBAL MARINE, INC., ON BEHALF OF NATIONAL OCEAN INDUSTRIES ASSOCIATION

Mr. ORTIZ. Mr. Sleet.

Mr. SLEET. Thank you, Mr. Chairman and members of the Subcommittee. I am Bob Sleet, Vice-President and Treasurer of Global Marine Inc., in Houston, Texas. Our company is primarily engaged in offshore drilling around the world, and we have 12 units currently located and working in the Gulf of Mexico. We also participate in oil and gas exploration, development, and production and provide drilling management services on a turnkey management basis.

I am here today to testify on behalf of more than 260 members of the National Ocean Industries Association, or NOIA. NOIA is the only trade association that represents all sectors of the domestic offshore oil and natural gas industry, including drillers, producers, service companies and manufacturers.

Our industry is able to perform tasks today that were almost unthinkable a decade ago. Water depth drilling and production records continue to be broken, reservoirs are produced more efficiently through horizontal drilling, hydrocarbon structures are more clearly seen through improved seismic interpretation and our record of excellence in environmental areas continues to grow. The

result of these advances is that the Gulf of Mexico, once considered to be a mature gas province, is an area full of many exciting new opportunities for both natural gas and oil.

The potential implications of these technological advancements are more jobs, increased revenue to the Federal Government and increased economic and energy security. As Tom just pointed out, in lease sale 147 held in March in the Central Gulf of Mexico, a total of 63 companies offered $277 million in high bids for 375 tracts offshore Louisiana, Mississippi, and Alabama.

It is critical to point out that these technological advancements result from the need for industry to become more efficient, to do more for less. At the same time, it is critical to point out that industry is willing to spend money for the technological advances as long as there is some certainty that the range of prices for natural gas and oil is stable and there is some parity in price between natural gas and oil.

The deepwater Gulf of Mexico, which is generally defined as deeper than 1,500 feet water depth, is one of the most promising offshore areas open to exploration and production. This area has heretofore been open only to the larger companies because of the higher risk and higher capital that is needed for both exploration and development. While industry has created the technology to explore in and produce from the deepwater, the high costs associated with deepwater operations under today's prices for oil and natural gas make many of the potential fields uneconomic to produce. With hydrocarbon estimates as high as 15 billion barrels of oil equivalent, as compared to Prudhoe Bay's initial reserve of 13 billion barrels, the deepwater Gulf has the potential by the end of this decade to create up to 100,000 new jobs, increase Federal revenues by $6 to $10 billion, reduce the Federal debt by $5 to $9 billion, and by the year 2017, improve the foreign trade balance by $23 billion.

More specifically, one of our member companies began producing from a deepwater field earlier this year. Eighty percent of the project's total cost of $1.2 billion was spent in the United States. More than 900 companies in 33 States and the District of Columbia received direct contracts to work on this project. The number of jobs multiplies considerably when you consider subcontracts let by these direct contractors. However, to fully recognize the potential benefits of the deepwater Gulf of Mexico, some economic assistance from the Federal Government is necessary to encourage industry's investment.

The deepwater is not just an area for the largest of the offshore operators. We have one of our members who is an independent producer who is in the deepwater today, and once the transportation infrastructure is in place, we will see even more companies who will be able to venture into these areas.

The evolution of three-dimensional seismic processing of geophysical data has allowed many companies to take a second look at existing fields and hydrocarbon structures that for various reasons were passed over previously. Spurred by advancements and affordability, 3–D seismic has allowed many companies a better picture of hydrocarbon reserves below the surface and even to peer below the salt structures prevalent in the Gulf of Mexico. As a result, the subsalt play has aroused a great deal of renewed interest

in the Gulf of Mexico. There is a significant multiplier effect when dollars are spent in the Gulf of Mexico. For example, every $1 million invested in an offshore project results in 20 jobs being created. For every 10 jobs that are created offshore, 37 are created onshore.

There are a couple of issues that are of great concern to us that operate in the Gulf of Mexico. One of those is the Oil Pollution Act of 1990. This legislation, more than any other in recent history, if implemented, could do grievous harm to the domestic energy industry. Under the definitions of offshore facility and navigable waters of the United States, one could make an argument that even the U.S. Capitol building is an offshore facility. There are serious problems with strict implementation of the statute, and the required $150 million certificate of financial responsibility does not even consider the relative risks of an offshore spill.

The industry is further concerned about a piece of broad-reaching legislation known as the Gulf of Mexico Initiative, that would greatly increase the scope of EPA's mandate in the Gulf of Mexico and greatly expand its jurisdiction and authority despite the agency's single-mission mandate. There are no provisions for cost-benefit assessments or peer-reviewed science within the proposed legislative initiatives. Further, the bills ignore the multiple resource use of the Gulf of Mexico by not providing for full business and industry participation. Rather than working with a new bureaucracy, the industry would prefer to work within the existing Gulf of Mexico program headquartered at Stennis Space Center.

Given the current situation in the United States with declining reserves and production of natural gas and oil and increasing demand for energy, we believe it is incumbent upon Congress to work with industry to search for ways to maintain a healthy energy industry. A healthy domestic energy industry is in the public interest.

Thank you for this opportunity and at the end of the session, we are open for questions.

Mr. ORTIZ. Thank you.

[The statement of Robert E. Sleet, Jr. can be found at the end of the hearing.]

STATEMENT OF WILLIAM F. JENNINGS, VICE-PRESIDENT, NOBLE DRILLING, INC., ON BEHALF OF INTERNATIONAL ASSOCIATION OF DRILLING CONTRACTORS

Mr. ORTIZ. Mr. Jennings.

Mr. JENNINGS. Good afternoon Mr. Chairman and members of the Committee. I am William F. (Bill) Jennings, Vice President of Noble Drilling. I am based in Lafayette, Louisiana. We operate 17 rigs in the Gulf of Mexico.

I appear today on behalf of the International Association of Drilling Contractors, the IADC. IADC is a trade association representing virtually all oil and gas drilling contractors operating worldwide, both onshore and offshore, including all contractors operating offshore in U.S. waters. IADC is pleased to have the opportunity provide testimony on the state of offshore technology and training.

Your invitation specified that we address the issue of well control. Accordingly, representing the drilling industry, I will confine my remarks to the technology primarily associated with the drilling

mode and not the production mode. The well control systems used by the drilling industry have proven highly dependable. The primary control system consists of what we call the BOP, the blowout preventer stack and/or diverter, choke manifold, safety valves, and associated piping and valves.

The well control system is tested weekly with no more than 7 days between tests. Time extensions can be granted by the MMS. The results of the test are logged in the daily drilling report and checked by the MMS on each visit on the well site.

Blowout preventer systems are designed and installed for the purpose of preventing the uncontrolled flow of fluids from the well. The preventer system is rated for pressures exceeding any pressure expected at the surface during the well program.

When we first started in the Gulf of Mexico, our preventers were at 5,000 psi. All preventers are up to 10,000 psi because of the deeper drilling that we are doing in the Gulf and some preventers are 15,000 psi.

The BOP stack consists of components stacked vertically around the pipe, the drill string or casing, designed to contain the formation fluids encountered within the well bore. Each element of the stack is independently controlled, allowing for several components to be activated together or in sequences.

An accumulator system is utilized for control of the stack. This storage of fluid under pressure is designed to exceed a normal cycle requirement by 50 percent without recharging. Closing speeds for the functions of the stack are regulated and rigidly enforced. Thirty seconds is normally the closing speed. Control stations are mounted in readily accessible areas with a remote operating panel mounted a safe distance away from the well bore.

Each station is tested weekly to ensure it can open and close the stack in a timely manner. Test results are recorded in a daily drilling log. Also mounted on the stack are the choke and kill valves. The choke valve is used to direct the flow of fluids to the choke manifold. The kill valve is used as an inlet to direct fluids into the well bore in case the well has to be killed.

A bank of high pressure valves are arranged on the rig floor and they are called the choke manifold. Fluid flows from the BOP are directed through the choke manifold to control the flow on one side of the manifold. Through the kill line side of the manifold, fluids can be directed to the well bore to kill the well, if necessary. This allows circulation within the well bore so the pressures can be bled off at a controlled rate and new fluids introduced into the well to kill it. Like the BOP, this system is also designed with backups in place in case of component failure and is tested weekly with test results recorded in the daily drilling log.

Safety valves are maintained in the drill string to prevent the flow of fluids from the pipe. These valves undergo the same rigid testing and documentation as the BOP and the choke manifold. Also like the other components of the well control system, the safety valves have backups in case of failure.

In some drilling areas, we have encountered sour gas and have had to develop protection for the BOP to handle hydrogen sulfide and carbon dioxide. In deeper waters, we have developed the subsea stack which is landed and sits on the bottom of the sea bed.

With horizontal drilling we have had to develop the rotating annular preventer. A rotating annular preventer differs from the conventional annular BOP by a set of seals made to allow the drill pipe sealing element to rotate. This rotation allows the well to be closed and still enable drilling. This greater control is of particular importance in pollution prevention as fluids coming up the bore can be directed and produced or recovered.

Training of the personnel in the offshore environment is our highest priority function. Each individual involved in the drilling operation is certified in well control for that job. This certification must be by a MMS-approved school and recertification must be obtained each year. Emergency drills simulating well control problems are conducted routinely with the response time recorded on the daily drilling log. Drills are initiated in both announced and unannounced sessions and reviewed by the supervisors at the well site. Continuing education in well control is conducted on board the rigs as well as in a certified third party school. In schools, students are given hands-on training with simulators programmed to duplicate actual case histories and situations created by the instructor.

The IADC conducts annual international well control conferences with systems and technology developments obtained from research and development of operation procedures can be presented and discussed. IADC well control conferences have developed into a fora in which oil companies, drilling contractors, and service companies can exchange views concerning new and innovative well control technology, training methods, and safety standards. In 1994 alone, IADC will host well control conferences in Norway, Singapore, and the United States. So we get worldwide exposure.

To respond to the industry's need for quality training, IADC is developing a "Model Well Control" program to establish uniform standards for well control training schools worldwide. This program establishes minimum training guidelines for fundamental and supervisory job skills required to perform effective well control operations at the rig site. The main purpose of the program is to develop a core well control training curriculum which identifies fundamental well control concepts, emphasizes fundamental job skills other than those related to rig-specific equipment, maintenance, and safety; is applicable worldwide, targets rig operating personnel; specifies performance criteria that encompasses the following: Recognition of well control events, measurement of current well parameters, and proper response to observations and measurements.

We are moving to establish a comprehensive IADC format well control training school accreditation program during 1994. The accreditation system will recognize training schools which meet IADC's established criteria, and will be available in the world where there are currently no well defined regulatory regimes regarding well control. In addition, IADC seeks eventually to be recognized by government entities such as the MMS as an official accrediting agency.

If I can furnish the Subcommittee any other technical information, please advise me or the IADC. Thank you for letting us be here today.

Mr. ORTIZ. Thank you Mr. Jennings.

[The statement of William F. Jennings can be found at the end of the hearing.]

STATEMENT OF DR. MICHAEL CHAMP, DIRECTOR, WASHINGTON DC OFFICE, GEOCHEMICAL AND ENVIRONMENTAL RESEARCH GROUP, TEXAS A&M UNIVERSITY

Mr. ORTIZ. Dr. Champ.

Dr. CHAMP. I am Michael Champ, a senior scientist with the Geochemical Environmental Research Group at Texas A&M.

We are a research group that works both for industry and the U.S. Federal Government and some seven nations. We have offices in Singapore, Moscow, Malaysia, Houston, and Washington, DC.

We currently do about a third of our research in the Gulf of Mexico, about a third in the continental States and about a third overseas.

We have been involved in evaluating technologies. We have been involved in developing and assessing the effectiveness of technologies and protocols, and I thank you very much for the invitation to participate in today's hearing.

In some 30 years that I have been involved in research and development, I have served in five different Federal agencies. I was a senior science advisor at EPA under Ruckelshaus. I have a lot of experience in the regulatory and the environmental research and development area.

I am here today to talk about something that we have seen evolve in the last couple of years that we like to call the Double Good Theory. We sort of stole this from the chewing gum people and we apologize for that. Basically, we have seen something occur, and I will chronologically present it to you.

Formerly the oil industry believed that the environment cost you money, cost you jobs and, it was a bad word. Not so long ago the most hated words in the oil vocabulary were environmentalists followed by lawyers, probably followed by OPEC, followed by oil prices. And subsequently, the oil industry took the environmentalists head on and spent billions.

They hired lawyers and when that failed, they hired environmentalists. And consequently at the same time, some market forces were coming along that would change that whole scenario. And what I am getting at is that since 1990, U.S. companies, large and small, have developed advanced technologies and practices for application in the oil and gas industry that have double benefits.

They saved the environment. They saved dollars, and they are also increasing or finding new jobs, creating new jobs. Essentially these technologies are practices that are redefining the playing field. It is very interesting how this is being driven by a market force rather than a regulatory force.

In the 1990's, the oil industry has developed a proactive approach to environmentalism with bold new corporate environmental policies that are impressive.

First, they appear to consider environment first in their investment decisions. They operate with small, ecological footprints and they are operating to comply with the environmental regulations.

And in our mind, that means they are not trying to run the yellow lights or run any red lights. I have recently chaired two na-

tional panel discussions at national conferences to discuss the Double Good Theory, and I would like to present just a few examples of it. I have been able to collect some 30 or 40 examples. Some are much more cost-effective than others, but I think they have merit.

I have presented your staff with several articles and reprints of some of the papers discussing some of these technologies, but I would just like to talk about a couple.

One has come out of some work by Conoco's Midland division. They have developed an aromatic emissions unit. Basically it is an ARU, the technology is being developed. It recovers aromatic emissions that normally were flamed off or burned off from a rig.

And to give you an idea of the cost saving of these new technologies, the unit costs about $30,000 per well. That $30,000 is recovered in about 8 months. And out of some 200 units that we have looked at, they seem to be making a profit of $42,950 a year in recovered air emissions that were just burned off or lost. They have a 140 percent profit return on the technology.

Another technology that I wanted to talk to you about is from a small company. I wanted to show a large company and a small company to not bias or give you the opinion that only the large companies are able to do this or had the resources to do this. There is a small company in Texas called Mag-Well, Inc. that has been looking at scale and paraffin deposits in wells and in my testimony I present some of their results in the use of magnets at the pump in the well to control scale and paraffin deposits.

And I have some data that I presented to you that show a well from the South China Sea. I deliberately present this South China Sea one because it sometimes is easier to apply advanced technologies overseas than in the Gulf of Mexico, our U.S. waters.

This well saves Shell and this small tool that is put in the bottom of this well costs about $30,000. The impact of not having to cut wax out of this well and have the production stabilize at a greater flow level saves Shell over $600,000 a year. This is a tool that costs less than $23,000 on the market today. It is a small technology.

There are some 600 or 700 of these tools now in use. They are being used a lot in systems or wells that were closed out on land because they were no longer productive and there are several offshore.

But anyway, I wanted to present the concept of a Double Good Theory that there is a benefit from technology that is both environmental and economic. And I would like to encourage Congress, this esteemed Committee, to focus national attention and the media on the importance on the Double Good Theory. I think you are going to save the environment. You are going to save money and you are going to create a lot of new jobs.

Thank you very much.

Mr. ORTIZ. Thank you, doctor.

[The statement of Dr. Michael A. Champ can be found at the end of the hearing.]

STATEMENT OF JAMES F. FOX, GEOSCIENCE DIRECTOR, PHILLIPS PETROLEUM COMPANY

Mr. ORTIZ. We have Mr. James Fox. I know that we have a vote, but we will continue with the panel hearing and hopefully maybe one of the members can go vote and come back so that we can continue because we will have a series of votes.

Mr. Fox, you can continue with your testimony.

Mr. FOX. Thank you, Mr. Chairman and members of the Subcommittee. I am James Fox. I am Geoscience Director for Worldwide Exploration, a Phillips Petroleum Company.

Phillips is an integrated oil company and it is involved in all aspects of the petroleum business. We maintain a strong presence in the United States with over half of our worldwide production coming from North America.

We appreciate the invitation from the Committee to testify on the application of new technologies developed by our research and development groups to support the search for new reserves in the United States.

The search for oil and gas in the Gulf of Mexico first began in the 1940's. Since that time, the industry has drilled over 30,000 wells and discovered and produced over 20 billion barrels of oil equivalent, supplying a major portion of our country's oil and gas needs.

By the mid–1980's, the industry was convinced that most of the oil had been found on the Gulf coast and that production would continue on a steady decline.

It was at this time that a potential for a large new exploration trend was theorized, the subsalt. A great deal of the production in the Gulf of Mexico is found on the sides and over the tops of salt domes. They are the most common type of salt feature found worldwide and geologists believe that most of the salt features found in the Gulf of Mexico were typical domes.

But recent wells and new technology called three-dimensional seismic and depth migration made us change our minds about the way salt behaves in certain parts of the Gulf of Mexico.

These technologies in conjunction with laboratory models showed that salt can also move laterally instead of growing vertically, as in a typical dome. As the salt moves laterally, it covers thick sand that can become future oil reservoirs and trap large accumulations of oil.

In September of 1993, Phillips Petroleum Company and its partners announced an oil discovery called the Mahogany located 80 miles off the shore of Louisiana on Federal lease OCS–G–12008. This discovery was drilled to a total depth of 16,500 feet in 370 feet of water. We are currently drilling another well to determine the size of accumulation, but it could have reserves of 100 million barrels of oil equivalent.

Phillips is currently drilling additional subsalt prospects, with many more subsalt prospects to drill in the next years. We are also using the same technology to successfully drill wells that will bring new life to fields that have been producing for 50 years.

What is the technology that has allowed us to pursue the subsalt play? The technology is twofold. Three dimensional seismic data and the ability to depth migrate this data. Scientists use seismic

data to generate echoes off the rocks below the surface to determine the geology of the area and the best location to drill oil wells.

For many years, the technique was to collect two-dimensional seismic and view the earth along widely spaced vertical profiles.

Three-dimensional seismic allows the geoscientist to see the earth not just vertically, but horizontally. Three-dimensional seismic also serves another vital purpose. It allows geophysicists to display their data so that other professionals, including geologists and engineers, can visualize their findings allowing teamwork and problem solving never before possible.

Three-dimensional seismic alone is not sufficient to unlock the subsalt domain. Seismic data measures in time, but to see a true picture of the earth, we need to see in depth. Just as looking through a drinking glass distorts the image on the other side, the subsurface rock layers distort the time pictures seen by the seismic due to varying velocities in the subsurface.

To correct this distortion, researchers developed a way to correctly determine the time-depth relationships in the earth. It requires a supercomputer to perform the complex mathematics, an integrated team of professionals to develop the models, and a graphics work station to allow the team to visualize the results at every step of the process.

The results allow us to see the geology in the subsalt more clearly. This has lowered our exploration risk considerably at a time when industry is facing budget constraints, but the risks are still great. Every successful discovery is accompanied by several dry holes.

The typical well drilled in the subsalt play costs between $12 and $15 million, two to three times that of a typical nonsubsalt well. Supercomputers and three dimensional seismic data require large investment not found in drilling conventional wells.

The success of Phillips' Mahogany has had a significant impact on the rest of the industry. The latest lease sale was the most active sale in years. The demands for drilling rigs is also increased, bringing new jobs back to the Gulf Coast oil patch.

A key additional attraction of the subsalt potential is in its minimal future environmental impact. The current area of subsalt interest lies in the area well known to the industry and to government agencies with jurisdiction on the OCS. The region has been the subject of intensive studies and lies in close proximity to an existing infrastructure allowing for easy transportation via pipelines and therefore minimal environmental impact.

There are many challenges yet to be met in subsalt exploration. Phillips is still confirming the size of our Mahogany discovery prior to a final development decision, but we are very excited about the exploration results to date.

Again, Phillips thanks the Subcommittee for the opportunity to provide information on subsalt exploration and technology.

In addition to my written testimony, we have provided a videotape to each Subcommittee member on the subsalt play and the technology which I would recommend for viewing.

I would be happy to respond to any questions that you may have.

Mr. ORTIZ. Thank you very much.

[The statement of James F. Fox can be found at the end of the hearing.]

Mr. ORTIZ. We do have a vote in process right now. We will recess for a few minutes and then we will come back and I know that some of the members and myself will have some questions to ask of you.

[Recess.]

Mr. ORTIZ. Some of the members are on their way, and I think that within the next 25 to 30 minutes, we will be interrupted again for some more votes, but at this time, Mr. Weldon is here, and I am just wondering whether you did have an opening statement that you would like to introduce now.

STATEMENT OF HON. CURT WELDON, A U.S. REPRESENTATIVE FROM PENNSYLVANIA, AND RANKING MINORITY MEMBER, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

Mr. WELDON. Thank you, Mr. Chairman. Let me thank the witnesses and I apologize for coming in late. We have a number of things going on today.

Mr. Chairman, I want to commend you for holding this important hearing on the current state of offshore technology, research and development. The ability of U.S. companies to tap into the oil and gas reserves stored beneath the outer continental shelf in an economically and environmentally sound manner is dependent on the continued development of advanced oil and gas extraction technologies.

As you know, I have been a long-time proponent of environmentally-sensitive oil exploration. In 1992, Congressman Greg Laughlin, a colleague of ours from Texas, and I, he is senior member of this Subcommittee, formed the U.S.–FSU energy caucus to assist U.S. companies in developing the former Soviet Union's oil and gas reserves both on and offshore in a manner that would not do harm to the environment.

[Below is a portion of Mr. Weldon's testimony that was not stated at the hearing.]

The former Soviet Union, although blessed with enormous energy resources was, and is, technologically incapable of extracting those resources in an effective manner. Their lack of adequate know-how prevented the production of sufficient oil and gas to meet the Nation's energy need, forcing the Communist leadership to rely on ill-designed and dangerous nuclear power plants.

The U.S.-F.S.U. Energy Caucus is assisting U.S. companies to create partnerships with the governments of the newly independent Republics of the former Soviet Union. Superior U.S. technology forms the backbone of these partnerships which will not only help meet the energy needs of these nascent nations, but also help prevent the extreme environmental degradation which was the trademark of energy extraction operation in Communist Russia.

As with the former Soviet Union, exploration of the U.S. OCS can greatly benefit from improved technologies. Improvements in technology reduce risks to the environment, increase production efficiency and reduce operating costs. Together these factors can significantly impact the economics of OCS exploration, making economically marginal discoveries profitable.

Mr. Chairman, I would like to compliment you again for holding this hearing. I look forward to hearing from today's expert witnesses on the state of OCS technology and research, and their potential to help revitalize the U.S. oil and gas industry.

As a matter of fact, next week, the Chairman and I will be involved in a delegation going to the Soviet Union to further explore ways we can cooperate in the energy area.

One of the things that caused us to do this was that the former Soviet Union, while blessed with enormous energy resources, is very backward in terms of technology and extracting those resources. Many of our companies, perhaps some of you here, I know Marathon, McDermott Metals, have been very involved in Sakhalin and Danavacku and other areas, but we need to develop joint ventures with them because it helps them get the hard currency they need, helps us deal with our energy needs, and builds a better relationship between the two nations.

One of the things I will be asking you about during the questioning today is your opinion of the current state of technology in the former Soviet and in the Republics of Russia, and Kazakhstan, Tajikistan, Azerbaijan and the others, and what assistance you can provide.

I think improving technology, which you have talked about today and which I am very interested in, reducing risks to the environment, increasing production efficiency, and reducing operating costs is something all of us have to work together on.

We can't put our head in the sand and deny the need to explore and develop, and along with the Chairman, I look forward to working with our witnesses in making sure this happens in the best possible environmentally-sensitive way.

I would also, ask, Mr. Chairman, unanimous consent to insert in the record the statement of the Honorable Jack Fields, Ranking Republican Member of the Full Committee.

Mr. ORTIZ. Hearing no objection, so ordered.

[The statement of Mr. Fields follows:]

STATEMENT OF HON. JACK FIELDS, A U.S. REPRESENTATIVE FROM TEXAS, AND RANKING MINORITY MEMBER, COMMITTEE ON MERCHANT MARINE AND FISHERIES

Mr. Chairman, our Nation continues to import oil at an alarming rate. It is estimated that by the year 2000, we will be importing as much as 60 percent of our Nation's needs.

While exploration and development of oil and gas resources have been occurring offshore in the United States for almost 5 decades, our Government continues to restrict the domestic energy industry from recovering much of our Nation's resources.

I am pleased that the rate of domestic exploration and production has risen this year in the Gulf of Mexico, which is one of the last offshore areas open to development. One of the main reasons for this upswing in exploration is the increased use of new seismic technology and the development of new deep water production equipment.

New technology has been developed or refined not only to find new reserves of oil and gas, but also to make the offshore production industry safer. The Federal OCS oil and gas program continues to be our Nation's safest energy extraction program. Part of the credit for this accomplishment is due to the advances which have been made in environmental safety equipment on exploratory drilling rigs and production platforms.

Newly refined technologies such as three-dimensional seismic technology, subsalt imaging, directional drilling, and new blowout prevention equipment have changed the way companies lease, explore, and develop resources on the Federal OCS. These technologies have allowed companies to find new reservoirs even in areas where previous work had not shown significant reserves. These technologies have also allowed companies to drill for and produce hydrocarbon reserves in deep water areas which had previously been considered undevelopable.

I look forward to hearing today's witnesses discuss the current state of technology, how new technology affects development of new reservoirs, and how new technology

affects the cost of offshore production. I am particularly interested in emerging technologies which are being developed for use in offshore areas.

Mr. Chairman, I believe that the deep water areas of the Gulf are the future for our OCS oil and gas extraction program. It is important that we encourage and support our domestic industry to make the technological advances that are necessary to explore these deep water areas.

I look forward to working with you in this respect and I compliment you for scheduling this important hearing.

Mr. ORTIZ. I will begin by asking the entire panel, and maybe they can respond to my question. How expensive is subsalt exploration and production and what are the impacts of this cost on major and minor operators in the oil and gas industry and support industries in the Gulf of Mexico?

If any one of you wants to respond, feel free to respond to this question.

Mr. FOX. I suppose I will start, Mr. Chairman. As Phillips Petroleum Company, we are probably the most active company currently pursuing the subsalt play. Each well that we drill in the play averages between $12 and $15 million a well. Of course, we are early in the cycle and learning how to drill these wells, but it is very expensive.

We also have the technology cost of the supercomputers and the three-dimensional seismic. However, even with today's oil prices, you can see that the industry is very interested in this play, that looking at the economics with the recent participation in the lease sale, that obviously the industry believes that this is a play that we can make some money off of.

The competition participated in the sale. Small contractors, in the spirit of free enterprise, are setting up and starting to sell this technology to the industry and so I believe that even though it is very expensive right now, that the oil industry is actively starting to pursue it as well as the small subcontractors.

Mr. ORTIZ. But is it as expensive? I mean, a major operator and a minor operator, you drill, is it the same cost? Does it depend on the size of the tract or does it depend on once you get your survey or—I am just a little——

Mr. FOX. Of course when we approach these, we would like to think that every accumulation is large because of the economies of scale. It is early in the day yet to be able to say that.

What I can say is that there is a nice mixture of size of companies participating. As you know, our partners in the Mahogany discovery are Anadarko Petroleum and AMOCO. Anadarko is a large independent. Participating in the sale were several smaller independent companies bidding on subsalt leases. So it does look to be something that a large spectrum of companies, they all can be economic to them.

Mr. JENNINGS. The operating cost, Mr. Chairman, is directly related to the depth of some of these areas and some of them are in deeper waters. The deeper the water, the higher the cost basically.

Mr. SLEET. I think there is a further point about the subsalt.

Mr. ORTIZ. Get a little closer to your mike.

Mr. SLEET. Excuse me. In addition to the fact that you have got the multiplier effect that I talked about and some of the other ones have alluded to here, when you spend, let's say you spend $1 million offshore, you are creating another 20 jobs—another $4 million

that is being spent on shore at the same time that you have got the subsalt going on—it means additional jobs for a number of industries.

You have got the seismic contractors who are out shooting additional seismic because of this. You have got other operators, both small and large, who are enthusiastic about what they see in the subsalt who themselves are getting excited about that particular play, and other plays in the Gulf of Mexico, and I think you have got a certain renewed enthusiasm which is good not only for the industry, but I think it is good for the economy as well.

Mr. ORTIZ. Anybody else? If not, I would like to go to another question again for the panel. Can existing infrastructure in terms of equipment and personnel in the Gulf of Mexico support the development of potential subsalt reserves identified by subsalt prospecting?

Mr. FOX. I think one way to look at it is there are numerous oil and gas pipelines already existing offshore Texas and Louisiana, which will have capacity.

I know we are looking at using those facilities to be bringing on the production for many discoveries that we are going to be making in that trend. That is especially important through the shelf from an economic standpoint as well as an environmental reusing of that existing infrastructure.

The question of availability of rigs, I think you are seeing the rigs returning to the Gulf, so that part of the infrastructure is there. And again, the rest of the witnesses are showing that the industry is supplying the expertise to be able to drill these very deep, expensive wells too.

Mr. ORTIZ. Thank you.

Mr. JENNINGS. In April of 1993 we had 145 available rigs in the Gulf of Mexico. We now have 175 available rigs in the Gulf. The count continues to increase.

As far as the money we are willing to spend on rigs, we are ready to meet that challenge as far as what we have to do to drill deeper wells. Most of our equipment is already geared up to drill deep wells, so we feel like we are capable of meeting the challenge.

Mr. ORTIZ. Great. Anybody else? I have one more—go ahead.

Mr. FOX. The other point is, this technology is not only restricted to the offshore. It is moving on shore as well and the industry is supporting us in that. We are using this technology on shore in Louisiana and in Texas to be exploring in some of those old provinces with what we hope to be a success so that infrastructure is there as well.

Mr. ORTIZ. Great. I just have one more question and then I will pass on to the Ranking Member for some questions.

Now that the three-dimensional seismic surveys of the Gulf are marketed as speculative surveys by seismic contractors to everyone, MMS leasing policy may affect the balance of major and independent operators in the Gulf.

What is MMS' policy on offshore leasing of area wide tracts versus nominated tracts?

Mr. GERNHOFER. Mr. Chairman, area-wide leasing has been in effect now for a dozen years. When the administration came to office, it was decided that it is good policy to review practices that

have been in place for a long time to ascertain their efficacy and whether changes should be made or the situation left alone.

Last December, MMS put in the **Federal Register** a notice encouraging commenters to give us their opinions about how area-wide leasing was working or not working if they thought that. We received about 50 comments.

We are now in the process of finishing our analysis of those comments, and they will be factored into future lease sales. When we go out for comments on proposed lease sales, we will be asking some of those same questions, and also when we develop our new OCS Five-Year Program for the period 1997 to 2002, we will also use those comments.

Director Fry has indicated recently in several public forums that in his preliminary review of the comments, he did not see the need at this time for a change in the area-wide policy. He also pledged that if analysis did result in some recommendations for changes, that those changes would go through another public comment period, and that he was not going to simply drop the change on the Congress, industry and the public. However, right now, it looks like we will pretty much stay the course.

Mr. ORTIZ. Thank you. I would like now to ask the other members of the panel, I am not trying to put anybody on the spot, but how would changes in MMS' leasing policy impact on industry operation in the Gulf of Mexico?

Mr. FOX. I think it would have a pretty serious impact. Phillips is a very strong proponent of area-wide leasing instead of nominated tracts. We do operate in other countries worldwide that do have nominated systems.

We see it is a very extreme pulldown on manpower resources and with current low oil prices, we have a very restricted manpower pool.

If we have to be providing the manpower to provide documentations for nominations and presentations, it pulls our expertise away from being able to make discoveries across a broader sense, and so we are very much in favor of area-wide leasing.

Our operations are based on that. It seems to be a very efficient system for us to be able to assign manpower throughout the calendar year, and we have been very active through the last several lease sales as an example of that.

You asked an earlier question on speculative seismic. Yes, contractors are applying speculative 3–D seismic in the Gulf of Mexico. That has certainly helped the scale of economics for the broad industry.

As I stated in my testimony though, that 3–D seismic by itself is not the key to the subsalt play. It is the depth migration data. That is a very expensive process. It requires super computers to do. The industry is starting to respond to that, but so far the contractors do not have the computing power or the finances to be able to completely support that need for depth migration.

So, yes, the speculative seismic is an important key, but the depth migration is the next important step for the subsalt.

Mr. ORTIZ. Thank you, Mr. Fox.

Mr. Sleet.

Mr. SLEET. Mr. Chairman, I think just to echo what Mr. Fox has said, the industry, over this past dozen years, has been operating under the area-wide leasing program and it is set up that way. There is a great deal of certainty as to that program.

It is because of that certainty that industry has been willing to spend the money, hire the personnel, and to acquire the kind of technology that is necessary to operate and develop the reserves in the Gulf of Mexico.

It is our strong belief that if the current system were changed to nominated tracts, that the Federal Government would not enjoy anywhere near the revenue that they have under the area-wide system.

In addition, the industry is going to be spending more money and in this area of uncertainty, industry is going to be put in jeopardy.

At the same time, when we look at this system, it is our belief that the system is not broken and it doesn't need to be fixed.

Mr. ORTIZ. Thank you.

Mr. Jennings.

Mr. JENNINGS. As representing the IADC, we support the same attitude. We do not want to see any changes in the current leasing system. It has worked real fine. Everyone is happy with it and it is no problem.

Mr. ORTIZ. Thank you. I would like at this moment to yield to my good friend, the Ranking Member, Mr. Weldon.

Mr. WELDON. Thank you, Mr. Chairman, and again, I thank the panelists for coming in today.

My first question, before I get into some of our domestic issues in this area, is, what, in your opinion, is the status and the sophistication of the offshore oil and gas technology in the former Soviet republics, Russia and the southern republics, and what amount of pollution is occurring because of its lack of technology—if it is your opinion that they have a substantial lack of technology, and certainly that has been my opinion. What experience do you have and what is your assessment of the technology in the former Soviet Union?

Mr. GERNHOFER. Congressman, as we meet here today, MMS has a delegation of technical experts in the former Soviet Union. Our assessment of their technological state is it is very poor and that pollution and environmental problems are very serious.

That is why, with the support of Congress, we have established these teams. This is an ongoing project for us, and we are helping the nations of the former Soviet Union to develop leasing or licensing regimes.

We have explained our inspection program to them, as well as our resource evaluation, inspection, and enforcement programs because we recognize that—as you do, they are going to extract those resources. That is not the question.

The question is, are they going to do it in a safe and environmentally sound manner? We are doing our part to answer that question in the affirmative.

Mr. WELDON. Have you put a percentage on there? I think it was McDermott Corporation that told me when I was in Moscow that it would at best be 25 percent efficiency. Is that what you would say?

Mr. GERNHOFER. I would defer to our chief engineer, Bud Dahenberger, but let me say with respect to pipelines, their own figure is a 50 percent loss rate—but we certainly wouldn't disagree with 25 percent overall.

Mr. CHAMP. I would just like to add, give a twist to the perspective here. We had an office in Moscow for about 2 years, and we have been extensively involved in the environmental side related to oil and gas.

We have a multi-million dollar contract with the Office of Naval Research looking at contamination in Russia, looking at nuclear contamination.

Our project started out as looking at the discharge of the major rivers to the Arctic circle. It has moved inland some. We now sample from the White Sea, which is over near Murmansk, all the way to the Laptev Sea, some whole 125 degrees.

We have 90 days of research ship time chartered from the Russians this summer and have a major offshore study under way looking at contamination both from nuclear submarines that have been dumped and from what is discharged off the land.

With the help of the National Science Foundation, we are creating this summer an environmental research center, which will be an industry university center. It will be located in the Tumen region, which is one of the major oil gas fields, and what we are focusing on there is the liability that U.S. companies are going to run into by taking personnel into these areas to develop resources.

Now, what we are really looking at, and I say that first, it is an environmental center and it is trying to help clean up the problem or identify the problem, but our phase of it for the industry support is to document where the problems are so they will understand better how to place their leases or their investments.

We have found areas in Russia where, if you were to stand on a bank of a small pond or a lake, you would receive in 45 minutes a lethal dose, and there are parts of Russia extremely dangerous to work in. We found in areas like Norilsk where there is heavy metal contamination, areas where there is nuclear waste contamination.

The life span of some of those people has been reduced from 50 years to 25, 29 years.

There is tremendous risk to U.S. companies to participate in oil and gas. The political and economic risks have been holding them back some, but as we uncovered this environmental risk, I think that is a much larger concern.

Mr. WELDON. I appreciate that. And if you would provide, either you personally or your organization a summary of the work you have done there, would be useful—part of our trip to Murmansk and Saint Petersburg in 2 weeks is to assess the status of the Soviet Union dumping its nuclear waste in the Arctic Ocean and Sea of Japan.

Mr. CHAMP. Sure.

Mr. WELDON. It was this Subcommittee last September that first raised the issue of the Yablokov Commission Report which detailed a continuous pattern of dumping of nuclear waste in an uncontrolled manner in the oceans, and we would appreciate the work that you have done in that area.

It is not the purpose of this hearing but it would help us as we prepare for our trip.

[At the time of printing, no information had been supplied by Mr. Champ.]

Mr. Chairman, I have another series of questions I would like to get Mr. Sleet or anybody else who wants to respond to this. Obviously it has been mentioned that Congress must work to help maintain a healthy energy industry.

I know you mentioned the Gulf of Mexico legislation and the OPA 1990 amendments and the concerns you have there.

I would like to know if there are other issues this Subcommittee needs to address to help maintain a healthy energy industry and if so, what are they? And also, are there other technologies that are being used overseas that you can't use here?

And if there are, what are they and why aren't they able to be used here? And not just you, but anyone else on the panel.

Mr. SLEET. The two primary pieces of legislation that concern us are OPA 1990 and the Gulf of Mexico initiative. The other areas that are of concern do not come to mind at this point, but we are in contact with staff and certainly will not hesitate to make you folks aware of it, and staff has been quite good about meeting with various members of the industry.

Your question about technology that is used overseas that is not in the Gulf of Mexico. I am not on the technical side of the business, but I do know that within NOIA, there are some of our members who tell me that in the area of drilling fluids, there are some fluids that are able to be used overseas that for one reason or another have not been approved by EPA and are not licensed to be used in the United States.

That is the primary area that comes to mind.

Mr. WELDON. For the record, if you could provide those to us, we would appreciate that.

Mr. SLEET. Be happy to do that.

[At the time of printing, no information had been supplied by Mr. Sleet.]

Mr. WELDON. Anyone else have any response?

Mr. JENNINGS. I agree OPA 1990 and the Gulf of Mexico legislation and Clean Water Act are the major issues we are looking at right now. And I agree with those two. Nothing else we can see.

We will research any technology that is used outside the United States and provide it to the Committee within the next couple of weeks.

Mr. FOX. Phillips is not looking for any incentives as far as supporting the exploration in the offshore Gulf of Mexico. However, if you are asking for something that impacts the use of technology, the technologies of using 3–D seismic and depth migration are very time-intensive.

The current leasing period of 5 years tends to put us sometimes in a position of not being able to completely do some of those studies in the timeframe that we would like to see.

These depth migrations gain reliability with increased points of control. After each well we drill, we will run the entire depth migration again, a process that takes many months to do, and so if anything, some additional time to evaluate some of those leases

would make the use of some of these higher and more expensive technologies more beneficial to us.

Mr. ORTIZ. Thank you.

Mr. Green.

Mr. GREEN. Thank you, Mr. Chairman.

Since we had questions on OPA 1990, I would like to ask Mr. Gernhofer, where are we at in the issue of the financial responsibility? Because I know that has been discussed for my year and 5 months I have been here in Congress and I know it is in your agency.

Mr. GERNHOFER. I thought that subject might come up, Congressman.

We issued what is called an "Advance Notice of Proposed Rulemaking". In response to that notice, we received over 1,700 comments, more than we received with any other proposal, from a wide variety of constituents, not only the traditional oil and gas industry, the States, boat marinas, recreational folks, sports fisherman, the whole gamut, as well as a number of comments from folks on the Hill.

I want to make very clear that an ANPR is not a notice of proposed rulemaking. It is a different animal and it basically says to the public at large and the Congress, "We have this law and we have questions about how to implement it through the regulatory process". Then we go through and we ask all of these questions in that ANPR.

We have divided the responses into two groups—those that are the substantive policy issues and those that are the legal issues. We have forwarded the legal questions to the Solicitor and are awaiting an opinion from the Solicitor as to the legal questions that have been raised.

We expect that opinion some time in the late summer. We have pledged to share that with Members of Congress since they have asked that we provide that analysis to them.

If you would like, I will summarize what the comments are. Basically, people are opposed to our definitions concerning OPA 1990. They are opposed to "navigable waters" as being too broad, a definition which would include, as some have said, two-thirds of the United States and virtually all of Alaska that isn't perpendicular.

Second, they feel that the $150 million requirement for certificates of financial responsibility is too high, will bankrupt the industry, is not reasonable, and is not based on any risk analysis. Third, most of the commenters responded that not only could they not afford the insurance coverage, but that the entities that normally provide such coverage have severe problems with the issue of direct access for liability purposes.

It is a very tough issue. If we are able, after we have received all this public input, to craft a reasonable rule that will carry out the intent of Congress, we will do that.

Failing our ability to do that, we will probably have no choice but to return to Congress and ask for a technical fix.

Mr. GREEN. Mr. Chairman, I know we share jurisdiction on that issue with the Coast Guard Committee, and that might be worth the effort over the next few months to have a hearing with the Coast Guard Committee, because I know how important it is to the

region you and I represent and also Chairman Tauzin from Coast Guard.

We have to go vote. There are other questions I would like to submit. One of them was, it was reported that under optimum conditions, that the Gulf of Mexico operators, if they executed their planned drilling programs, that we would need additional mobile rigs to drill in South Bay 900 new wells this year, and coming from the Houston area, particularly with the ship channel, that made my heart jump on how many more people would be employed.

I wonder if that is really realistic since we are halfway through the year and if you could just as briefly as possible address it.

Mr. JENNINGS. The first quarter we drilled 240 wells, so we are on schedule too.

Mr. GREEN. So you are on schedule for the 900 plus. Outstanding.

Mr. ORTIZ. Thank you. I know that there are some other members. Mrs. Bentley had some questions. I have some others on certification, they have to go through a certification every year.

I was wondering whether they have to pay a fee for that. But we will submit these questions to you in writing and you can respond to us.

That concludes the testimony for this hearing today. I want to thank you for your valuable testimony and insight that you have shared with us today. We will submit the questions to you and we want to work with you, and thank you very much. Some of the information, before we go to Russia, maybe you ought to supply.

[Whereupon, at 3:15 p.m., the Subcommittee was adjourned, and the following was submitted for the record:]

Testimony of
Thomas Gernhofer
Associate Director for Offshore Minerals Management
Minerals Management Service
United States Department of the Interior
Before the
Merchant Marine and Fisheries Committee
Subcommittee on Oceanography, Gulf of Mexico,
and Outer Continental Shelf
May 19, 1994

Mr. Chairman and Members of the Subcommittee, I am pleased to appear before you today to testify on emerging technologies and research being pursued by the Minerals Management Service (MMS) of the U.S. Department of the Interior.

As you are aware, the MMS has the statutory authority to manage the leasing, exploration, and the development of mineral resources on the Outer Continental Shelf (OCS). In this capacity, MMS must oversee the development of offshore oil and gas resources and assure that such developments are conducted in a safe, pollution-free manner using acceptable technology.

Through its Technology Assessment and Research Program, MMS supports an active effort to understand the engineering constraints for offshore operations, especially as related to the structural integrity of structures and pipelines, the prevention of pollution, and the technologies necessary to clean up an oil spill should one occur. In essence, the program provides an independent assessment of the status of OCS technologies and, where deemed necessary, investigates technology gaps and provides leadership in reaching solutions. The program also facilitates a dialogue among engineers in the industry, the research community, and MMS in dealing with the many complex issues associated with offshore oil and gas operations.

The research program was established in 1975 and has become an integral part of MMS's mission. It was initiated in the spirit and letter of the Outer Continental Shelf Lands Act which specifies "The Secretary (of the Interior). . . shall require, on all new drilling and production operations, and wherever practicable, on existing operations, the use of the best available and safest technologies which the Secretary determines to be economically feasible wherever failure of equipment would have a significant effect on safety, health, or the environment. . ." Information derived from the research is integrated into offshore operations and is used in making regulatory decisions pertaining to the issuing of permits and the reviewing of applications.

The majority of MMS sponsored research is performed not within the agency but by academic institutions, private industry, and Government laboratories. Studies are performed in cooperation

with the offshore industry or with other Government agencies, Federal, State and foreign. The cooperative approach is increasingly prevalent, mostly as a result of increasing research costs and the need to learn from accidents such as the North Sea Piper Alpha accident, in which there were many fatalities, and the Prince William Sound oil spill, which though not an offshore accident, prompted more research on oil spills.

This cooperative aspect of the program also provides an important multiplier of funding support, currently about 4 to 1, but probably of equal importance is the discourse it provides with the industry and other regulatory agencies. The ability to work together to assess a particular technology or the rationale for future technical developments helps both industry and Government. Such cooperation and dialogue allows us to understand each other's needs and reduces possible conflicts or misunderstandings concerning the engineering feasibility of an operational decision. As a result of this dialogue, a valuable exchange of information is provided between MMS and the industry.

For purposes of program planning, management, and to enhance our ability to address current technological needs, the program is divided into four subprograms: operational safety; structures and pipeline integrity; air-pollution control; and oil-spill detection, containment, and cleanup. Since the inception of the program, approximately 225 projects have been conducted, yielding roughly a thousand technical reports and papers. The program has proven to be a balanced, comprehensive approach to the investigation of the regulatory or safety related technologies associated with the industry's movement into more hostile frontier environments, while maintaining the existing aging facilities.

Oil Spill Research Program

The MMS expanded its oil spill response technology program as a result of the spill in Price William Sound. Much emphasis is being placed on the burning of spilled oil in place on the ocean's surface. High burn efficiencies have been measured on both fresh and weathered crude oil of various types under laboratory conditions. In-situ oil burning will be tested in large-scale experiments, and an at-sea test burn was held recently offshore Newfoundland. The products of combustion, together with the fate of the oil products are also under investigation.

Other aspects of the research program include reformulation of existing dispersants, formulation and tests of oil-treating agents to enhance collection or burning, mechanical recovery systems, and spill detection systems.

The MMS's technological research has developed a new dimension with the reopening of the only oil spill response test facility in the United States where full-scale equipment can be tested. Commissioned in the early 1970's, the facility was closed in 1988, but was reopened in 1992 and is now managed by MMS. The Oil and Hazardous Materials Simulated Test Tank (OHMSETT) facility is capable of simulating a wide range of wave and meterological conditions, making it possible to test a variety of devices and techniques for oil spill control in an environmentally safe setting, under ocean conditions, and before field evaluations are attempted. The facility is located in Leonardo, New Jersey and contains an open-air tank 667 feet long by 65 veet wide and 8 feet deep (holding 2.6 million gallons of water).

3-D Seismic Data and Information and Subsalt Prospects

The evolution of three-dimensional (3-D) seismic data and information, in conjunction with interactive computer workstations, has made it possible to more accurately define and assess the potential for oil and gas occurrence on the OCS, especially with regard to subsalt prospects. The 3-D information is used to delineate, in greater detail than that of traditional two-dimensional (2-D) information, subsurface geologic conditions associated with the occurrence of natural gas and oil. This directly results in a better ability to do the following:

* More accurately determine fair market value for the OCS tracts being offered for lease, including tracts containing subsalt prospects;

* Assess undiscovered amounts of natural gas and oil;

* Quantify reserves of natural gas and oil on the OCS; and

* Perform postlease comparative analyses of company-submitted bids for acceptance or rejection.

Workstations are essential to take full advantage of the 3-D information as applications have become more sophisticated, evolving from a data tool to delineate reservoirs for development and production wells to that of an exploration tool. The role of 3-D seismic data has expanded in recent years. Over 80 percent of the offshore surveys were 3-D surveys in 1991, while now it is approaching 100 percent. As a result, acquisition costs have been coming down and recent innovations have made this information usable on workstations, whereas in the past super computers were needed. This is "cutting edge" technology and changes are rapidly affecting exploration techniques and success rates. These innovations have made it more accessible to others

within the industry--not just major companies. Independents have been better able to participate in the Gulf of Mexico because 3-D seismic technology now makes it easier to identify smaller prospects.

Improved processing techniques in displaying 3-D seismic information make it extremely valuable in identifying subsalt prospects and structures. For many years, it has been known that significant salt structures exist in the offshore Gulf of Mexico, not only as domes, but as salt sheets covering upwards of 60 percent of the Gulf of Mexico. The more traditional 2-D seismic information has problems imaging structures below these salt bodies. However, specific processing techniques involved with 3-D seismic are used to enhance and identify prospects below the salt.

The use and implementation of 3-D seismic technology has opened up this new "frontier" play of subsalt exploration in the Gulf of Mexico. The first announced subsalt discovery was made on Mississippi Canyon Block 211 by Exxon (1990), which drilled through some 3,000 feet of salt and encountered oil and gas in five sands between 10,000 and 13,000 feet in depth. This was followed by the recent "Mahogany" discovery by Phillips on Ship Shoal Block 349 in 1993. This prospect was drilled through 3,000 feet of salt to a total depth of 16,500 feet. The areal extent of the entire Gulf of Mexico subsalt play extends from the High Island and Garden Banks areas in the Western Gulf across the Central Gulf to the Mississippi Canyon area near the mouth of the Mississippi River.

Future Directions in Research

The following areas have been identified as future technological needs for which MMS will pursue research:

- **Safety of Deep-Ocean Operations**--Technology and procedures for well control (blowout prevention), recontrol of blowing wells, and shallow gas diversion are being further advanced to ensure that deepwater sites (i.e., 4,000-6,000 feet) can be developed with the same reliability and safety as have been demonstrated for shallow-water sites of the Gulf of Mexico. Directional drilling is the norm in the offshore oil and gas industry; however, the industry is now using true horizontal drilling to extend field developments. The MMS is assessing this technology to see if existing well control requirements are adequate or if they can be improved to reduce potential risks.

- **Safety of Existing Aging Structures and Pipelines**--A systematic verification strategy for regulating old or damaged structures and pipelines to ensure an acceptable

level of integrity during their remaining service lives needs to be determined. With approximately 4,000 structures and over 20,000 miles of pipelines in the Gulf of Mexico, a concerted effort is necessary to reduce any potential risks associated with their continued operation. The MMS recently sponsored two workshops, one on the safety of offshore pipelines and the other on reassessment methods for existing platforms. Among other objectives, we wanted to identify areas of needed research. Based on these workshops, several research efforts were initiated to develop assessment methodologies for both pipelines and platforms. Additional studies will be conducted to provide an accurate and detailed knowledge base of existing service conditions to assess the integrity of offshore platforms and pipeline systems.

- **Engine Exhaust Emission Reduction Offshore**--The control of exhaust emissions offshore is essential for oil and gas operations in California and is increasingly important in the Gulf of Mexico. The MMS, in cooperation with the industry, will undertake a development and demonstration project for reducing nitrogen oxide emissions from gas turbines to meet existing air quality requirements.

- **Offshore Earthquake Monitoring and Analysis**--Data on the response of seafloor sediments to earthquake-induced motions have been scarce, thus, introducing significant uncertainty into the seismic hazards of offshore structural design. To reduce this uncertainty, MMS, in cooperation with the industry, is supporting a program to develop and install seafloor instrumentation to measure seismic motions. Data collected will be used to verify, or if necessary, modify existing codes and standards.

- **Risk and Reliability of Operations**--As operations move into deeper waters, using new or improved technologies, improved analytical methodologies are required to ensure safety of life and property and to avoid pollution. Accident investigations in recent years, most notably of the Piper Alpha disaster in the North Sea, reveal that seemingly simple errors in judgment can trigger a sequence of mishaps which can lead to catastrophic loss of life and property. These errors may result from some combination of element and system design, fabrication, or human error.

  The MMS has conducted two workshops on risk and reliability and has funded studies to determine appropriate risk analysis procedures for OCS operations and the kinds of information needed for analysis. Our work in this area will also be factored into future development of the Safety and Environmental Management Program, or SEMP, and work being carried out by industry in accord with RP75, the American

Petroleum Institute's recommended practice for SEMP planning.

- **Composite Materials for Offshore Operations**--Composite materials are increasingly considered for use in offshore petroleum production engineering operations. This is particularly true for deepwater offshore platform and drilling technologies. Composite materials offer substantial weight reduction, superior fatigue and corrosion resistance, outstanding acoustic, vibration damping and energy absorption, and unlimited potential of innovative material and structural tailoring to desired stiffness and strength. Coupled with low maintenance and low total life-cycle costs and ease of fabrication and construction, composite materials are an enabling technology ideally suited for both immediate and future deepwater challenges and may offer the highest payoff potential in the offshore operations.

  Success in realizing this great potential will require understanding the existing composites technology base and its future development, unique structural requirements of deepwater offshore operations, and economic and reliability constraints in the use of composites. The MMS last year sponsored a workshop on composites to identify the gaps between the state of the art and state of practice and to determine and prioritize research initiatives aimed at allowing safe and economical use of composites by the offshore industry.

  It is our understanding that the Bureau of Mines has conducted extensive composite materials research examining factors of wear and corrosion that are applicable to a marine environment. The MMS will consult with the Bureau of Mines on research needs in this area.

I have highlighted in my testimony some of the research efforts being sponsored by MMS as the industry moves toward opening the deep ocean to offshore oil and gas development. Among the other projects being conducted are studies of deepwater foundation concerns, (i.e., drilled and grouted piles and hydrates); deepwater pipeline systems; ice scouring and permafrost in the Arctic; and oil-spill and containment procedures for both open ocean and Arctic conditions.

A concerted effort is being made by the industry, as well as MMS and other regulatory agencies, to meet these challenges. The industry has historically demonstrated the ability to develop the required technologies to meet needs arising from a move into new areas. Because of the extensive research being conducted by both Government and industry and the continual accumulation of

frontier area experience, the future holds much promise for further developments.

Mr. Chairman, this concludes my prepared remarks. However, I will be pleased to answer any questions the Subcommittee may have.

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National Ocean Industries Association

Testimony of
Robert E. Sleet, Jr.
on behalf of the
National Ocean Industries Association
before the Subcommittee on
Oceanography, Gulf of Mexico and OCS
House Merchant Marine and Fisheries Committee

May 19, 1994

Good afternoon, Mr. Chairman and members of the Subcommittee. I am Bob Sleet, Vice President and Treasurer of Global Marine Inc. Our company is primarily engaged in offshore drilling around the world with 12 units currently located and working in the Gulf of Mexico. We also participate in oil and gas exploration, development and production and provide drilling management services on a turnkey management basis. Today I am testifying on behalf of the more than 260 members of the National Ocean Industries Association, or NOIA. NOIA is the only national trade association that represents all sectors of the domestic offshore oil and natural gas industry, including drillers, producers, service companies and manufacturers. Our industry is able to perform tasks today that were almost unthinkable a decade ago. Water depth drilling and production records continue to be broken, reservoirs are produced more efficiently through horizontal drilling, hydrocarbon structures are more clearly seen through improved seismic interpretation and our

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record of excellence in environmental areas continues to grow. The result of these advances is that the Gulf of Mexico, once considered to be a mature gas province, is an area full of many exciting new opportunities for both natural gas and oil.

The potential implications of these new technological advancements are more jobs, increased revenue to the federal government and increased economic and energy security. As an example of this, lease sale 147 held in March in the Central Gulf of Mexico yielded more bids than the past two Gulf sales combined. A total of 63 companies offered 277 million dollars in high bids for 375 tracts offshore Louisiana, Mississippi and Alabama.

It is critical to point out that these technological advancements result from the need for industry to become more efficient - to do more for less. Further, this too is critical, industry is willing to spend money for the technological advancements as long as there is some certainty that the range of prices for natural gas and oil is stable and there is some parity in price between natural gas and oil.

The deepwater Gulf of Mexico, generally defined as deeper than 1,500 feet, is one of the most promising offshore areas open to exploration and production. This area has heretofore been open only to the larger companies because of the risk and very high capital cost of both exploration and development. While industry has created the technology to explore in and produce from the

deepwater, the high costs associated with deepwater operations under today's prices for oil and natural gas make many of the potential fields uneconomic to produce. With hydrocarbon estimates as high as 15 billion barrels of oil equivalent, as compared to Prudhoe Bay's initial reserves of 13 billion barrels, the deepwater Gulf has the potential to, by the end of this decade, create up to 100,000 new jobs, increase federal revenues by 6 to 10 billion dollars, reduce the federal debt by 5 to 9 billion dollars and, by the year 2017, improve the foreign trade balance by 23 billion dollars. More specifically, one of our member companies began producing from a deepwater field earlier this year. Eighty percent of the project's total cost of 1.2 billion dollars was spent in the U.S. More than 900 companies in 33 states and the District of Columbia received direct contracts to work on this project. The number of jobs multiplies considerably when you consider subcontracts let by these direct contractors. However, to fully recognize the potential benefits of the deepwater Gulf of Mexico, some economic assistance from the federal government is necessary to encourage industry's investment.

The deepwater is not just an area for the largest of the offshore operators. An independent producer in our membership is very active in the deepwater today, and once the transportation infrastructure is in place, even more companies will be able to venture into these areas.

The evolution of three-dimensional seismic processing of

geophysical data has allowed many companies to take a second look at existing fields and hydrocarbon structures that for various reasons were passed over previously. Spurred by advancements and affordability, 3-D seismic has allowed many companies a better picture of hydrocarbon reserves and to even peer below the salt structures prevalent in the Gulf of Mexico. As a result, the subsalt play has aroused a great deal of renewed interest in the Gulf of Mexico. This means more work for the entire spectrum of the offshore industry. There is a significant multiplier effect, for example, every 1 million dollars invested in an offshore project results in 20 jobs being created. For every 10 jobs that are created offshore, 37 are created onshore.

NOIA held its annual meeting here in Washington last month, and despite the hard times our industry has faced, the overall word from our membership was positive. The industry has the potential to increase domestic production considerably, bring along new jobs, increase revenue to the federal government and lower the country's annual bill for imported oil. However, our membership is also greatly concerned by proposals which would have serious negative implications for the health of the Gulf Coast and the energy industry.

One example is implementation of the Oil Pollution Act of 1990. This legislation, more than any other in recent history, if rigidly implemented, could do grievous harm to the domestic energy industry. Under the definitions of offshore facility and navigable

waters of the U.S., one could make an argument that even the U.S. Capitol building is an offshore facility. There are serious problems with strict implementation of the statute, and the required 150 million dollar certificate of financial responsibility does not even consider the relative risks of an offshore spill. This requirement is inherently unfair as it creates a business barrier that smaller operators cannot overcome. These regulations could not only eliminate the potential implications of the new technologies we are talking about today, they could eliminate a host of the companies operating offshore. That, in turn, would mean no work for the companies that drill the wells and provide other products and services for the producers. Implementation of OPA'90 in its present form would likely put into jeopardy the current number of rigs operating in the Gulf of Mexico, 127, not to mention the employment of each of the 75-90 individuals who work on each unit. It is our belief that Congress did not have these results in mind when it passed OPA'90.

The industry is further concerned about a piece of broad-reaching legislation, known as the Gulf of Mexico Initiative, that would greatly increase the scope of EPA's mandate in the Gulf of Mexico and greatly expand its jurisdiction and authority despite the agency's single-mission mandate. There are no provisions for cost-benefit assessments or peer-reviewed science within the proposed legislative initiatives. Further, the bills ignore the multiple resource use of the Gulf of Mexico by not providing for full business and industry participation. Rather than working with a new

bureaucracy, the industry would prefer to work within the existing Gulf of Mexico program headquartered at Stennis Space Center.

I will conclude my comments as to the potential of the domestic offshore by quoting from a paper on natural gas written by Gary L. Lore of the Minerals Management Service: "Considerable quantities of unproved reserves exist in new field discoveries and in old fields. Continued activity in these old fields and plays spurred by the application of new technologies have resulted in new reservoir discoveries in old fields and new field discoveries in old plays. Current assessments of undiscovered resources under favorable economic scenarios may exceed the volume of proved natural gas reserves to date."

Given the current situation in the U.S., with declining reserves and production of natural gas and oil and increasing demand for energy, we believe it is incumbent upon Congress to work with industry to search for ways to maintain a healthy energy industry. A healthy domestic energy industry is in the public interest. Thank you for this opportunity to testify, and I will answer any questions you may have.

INTERNATIONAL ASSOCIATION OF DRILLING CONTRACTORS

STATEMENT

ON

STATE OF RESEARCH AND DEVELOPMENT

FOR

OFFSHORE TECHNOLOGY AND TRAINING

Mr. William F. Jennings

Vice President, Noble Drilling (U.S.) Inc.

(Gulf Coast Marine Division)

on behalf of the

INTERNATIONAL ASSOCIATION OF DRILLING CONTRACTORS

Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf

Committee on Merchant Marine and Fisheries

United States House of Representatives

Washington, D.C.

May 19, 1994

Good afternoon, Mr. Chairman. My name is William F. Jennings and I am the Vice President of Noble Drilling Inc., based in Lafayette, Louisiana. I appear today on behalf of the International Association of Drilling Contractors (IADC). IADC is a trade association representing virtually all oil and gas drilling contractors operating worldwide, both onshore and offshore, including all contractors operating offshore in U.S. waters. IADC is pleased to have the opportunity to provide testimony on the state of offshore technology and training.

Your invitation specified that we address the issue of well control. Accordingly, representing the drilling industry, I will confine my remarks to the technology primarily associated with the drilling mode, not the production mode.

The well control systems used by the drilling industry have proven highly dependable. The primary control system consists of the BOP (Blow Out Preventer) stack (and/or diverter), choke manifold, safety valves, and associated piping and valves. The well control system is tested weekly with no more than seven days between tests (time extensions can be granted by MMS). Results of the test are logged in the daily drilling report and checked by MMS on each visit to the well site.

Blowout preventer systems are designed and installed for the purpose of preventing the uncontrolled flow of fluids from the well. The preventer system is rated for pressures exceeding any pressure expected at the surface during the well program. The "BOP stack" consists of components stacked vertically around the pipe (drill string or casing) designed to contain the formation fluids encountered within the well bore.. Each element of the stack is independently controlled allowing for several components to be activated together or in sequences.

An accumulator system is utilized for control of the stack. This storage of fluid under pressure is designed to exceed a normal cycle requirement by 50% without recharging. Closing

speeds for the functions of the stack are regulated and rigidly enforced. Control stations are mounted in readily accessible areas with a remote operating panel mounted a safe distance from the well bore. Each station is tested weekly to ensure it can open and close the stack in a timely manner. Test results are recorded in the daily drilling log. Also mounted on the stack are the choke and "kill valves". The choke valve is used to direct the flow of fluids to the choke manifold. The kill valve is used as an inlet to direct fluids into the well bore to "kill" the well.

A bank of high pressure valves are arranged on the rig floor and called the choke manifold. Fluid flow from the BOP is directed through a choke to control the flow on one side of the manifold. Through the "kill line" side of the manifold, fluids can be directed to the well bore to kill the well. This allows circulation with the well bore so the pressure can be bled off at a controlled rate and new fluids introduced into the well to kill it. Like the BOP, this system is also designed with backup in place in case of component failure and is tested weekly with test results recorded in the daily drilling log.

Safety valves are maintained in the drill string to prevent the flow of fluids through the pipe. These valves undergo the same rigid testing and documentation as the BOP and the choke manifold. Also, like the other components of the well control system, the safety valves have backups in case of failure.

In some drilling areas we have encountered sour gas and have had to develop protection for the BOP to handle hydrogen sulfide and carbon dioxide. In deeper waters we have developed the sub-sea stack which is landed and sits on the bottom of the sea bed. With horizontal drilling we have had to develop the rotating annular preventer. A rotating annular preventer differs from the conventional annular BOP by a set of seals made to allow the drill pipe sealing element to rotate. This rotation allows the well to be closed in and still enable

drilling. This greater control is of particular importance in pollution prevention as fluids coming up the bore can be directed and produced or recovered.

Training of the personnel in the offshore environment is our highest priority function. Each individual involved in the drilling operation is certified in well control for that job. This certification must be by a MMS-approved school and recertification must be obtained each year. Emergency drills simulating well control problems are conducted routinely with the response time recorded on the daily drilling log. Drills are initiated in both announced and unannounced sessions and reviewed by supervisors at the well site. Continuing education in well control is conducted on board the rigs as well as in certified third party schools. In the schools, students are given hands-on training with simulators programmed to duplicate actual case histories and situations created by the instructor.

IADC conducts annual international well control conferences where system and technology developments obtained from research and development or operation procedures can be presented and discussed. IADC well control conferences have developed into fora in which oil companies, drilling contractors, and service companies can exchange views concerning new and innovative well control technology, training methods and safety standards. In 1994 alone, IADC will host well control conferences in Norway, Singapore, and the U.S.

To respond to the industry's need for quality training, IADC is developing a "Model Well Control" program to establish uniform standards for well control training schools worldwide. This program establishes minimum training guidelines for fundamental and supervisory job skills required to perform effective well control operations on the rig. The main purpose of the program is to develop a core well control training curriculum which:

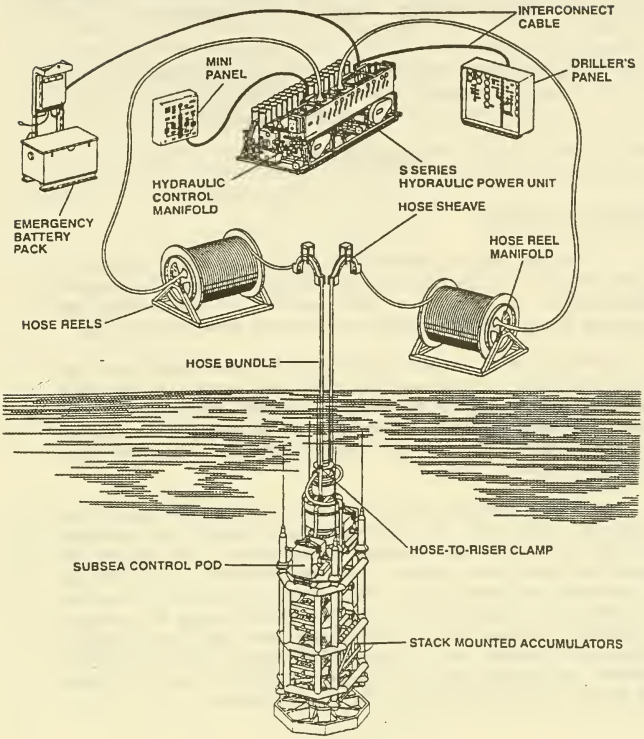
- Identifies fundamental well control concepts.

- Emphasizes fundamental job skills other than those related to rig-specific equipment, maintenance and safety training.
- Is applicable worldwide.
- Targets rig operating personnel.
- Specifies performance criteria that encompasses the following:
  - Recognition of well control events.
  - Measurement of current well parameters.
  - Proper response to observations and measurements.

We are moving to establish a comprehensive IADC format well control training school accreditation program during 1994. The accreditation system will recognize training schools which meet IADC established criteria, and will be available in areas of the world where there are currently no well defined regulatory regimes regarding well control. In addition, IADC seeks eventually to be recognized by government entities such as the U.S. Minerals Management Service as an official accrediting agency.

If I can furnish the Subcommittee any other technical information supporting this statement, please advise me or IADC. Thank you again for this opportunity to highlight the sound technology and safety practices of the offshore drilling industry.

SUBSEA HYDRAULIC BOP CONTROL SYSTEM



Testimony of Dr. Michael A. Champ
Senior Scientist, Geochemical & Environmental Research Group (GERG), Texas A&M University

to the U.S. House of Representatives, Committee on Merchant Marine & Fisheries, Subcommittee on Oceanography, and Gulf of Mexico, and the Outer Continental Shelf

May 19, 1994

Executive Summary

I thank you for the invitation to participate in todays hearing. I would like to discuss the **Double Good Theory - "Advanced Technologies and Practices that do Both Environmental and Economic Good"** and its importance to the Gulf of Mexico and the OCS.

Formerly, the oil industry believed that "the environment" cost you money and jobs. Not long ago, the most hated words in an oil man's vocabulary were: (1) Environmentalists, (2) Lawyers, and (3) OPEC & Oil Prices. Subsequently the oil industry took the environmentalists head on and spent billions. They hired lawyers & when that failed they hired environmentalists.

However, a major change has occurred in the past few years in the oil industry. Since 1990, U.S. companies (large and small) have developed advanced technologies and practices for application in the oil and gas industry that have double benefits - save the environment, and dollars for the industries that develop or use them. These technologies or practices are redefining the playing field. In the 90's the oil industry is developing a proactive approach to environmentalism with bold new corporate environmental policies that: (1) consider environment first in investment decisions, (2) operate with small ecological footprints, and (3) comply with environmental regulations (no red or yellow lights).

I have recently put together two panel discussions at national conferences in which industry representatives (Chevron, Conoco, Inc., and Mag-Well Inc.) discussed their new double good technologies and practices. I would like to discuss the concept and give a few examples of technologies or practices and hand out a few articles about them. Because these technologies save or make industry dollars, they are more effective than regulation. This proactive approach should be the rule and not the exception.

If Congress were to focus national attention and the media on the importance of the Double Good Theory, they could save the environment, money, and create jobs all at the same time.

'Best Practices' Put Environment First

Editor's Note: The following articles, reprinted from the June, July and August issues of *The American Oil & Gas Reporter*, highlight environmental "best practices" developed by Conoco, Inc. The first article is based on the author's presentation for the Society of Petroleum Engineers' 1993 Distinguished Lecturer Series, and discusses the best practices philosophy and some relatively non-technical and common-sense environmental solutions for the industry. The second article examines a hydrocarbon vapor recovery unit for crude oil production facilities, and the third article reviews an aromatics recovery unit for natural gas glycol dehydration separators.

By Robert D. Kiker

MIDLAND, TX.–The environmental maxim for today's oil and gas industry must be to "leave light footprints, or none at all." Application of that principle–advocated last year in the Society of Petroleum Engineers' Distinguished Lecturer Series by Terry Thoem, Conoco's international manager of environmental affairs–is central to improving the way our industry is perceived by society.

But doing so requires that the industry change some of its past practices. "The way we have always done it" is not a satisfactory response to minimizing the industry's environmental impact. Ultimately, a commitment must be made at the engineering level to provide better technology and better practices for environmental protection.

To address environmental concerns, Conoco has established a set of guiding environmental principles (Table 1) that includes a standard for sustainable, cost-effective development. Adherence to this standard has required Conoco engineers to be more aware of environmental considerations. This awareness is a key element in developing new environmental initiatives and identifying successful programs.

The principle of sustainable development, as adopted by the United Nations' World Commission on Environment and Development, is defined as "development that meets the needs of the present without compromising the ability of future generations to meet theirs." Such development must, of course, be cost-effective. But in many cases, environmental engineering delivers its own set of cost benefits.

TABLE 1

Conoco Environmental Principles

- Adherence to corporate environmental policies
- Full compliance with all applicable environmental laws and regulations
- Taking actions beyond regulatory requirements that yield sustainable development and environmental benefit at reasonable cost
- Taking reasonable action to influence partnerships and joint venture operations, where we do not have control, to subscribe to our environmental initiatives

For sustainable development on a cost effective basis to occur, engineers must be aware of environmental protection initiatives and programs, or "best practices," related to their areas of operation, and must strive to incorporate those practices as well as develop new ones.

Often this requires a change in engineering perspective. Environmental protection is frequently viewed as an after-the-fact process that only adds costs or complexity to a project or operation. Instead of this win/lose perspective, environmental protection needs to be viewed from a win/win position. Engineers must be proactive in integrating environmental interests with traditional efforts so that the environment is protected at some cost benefit, or without burdening the project.

In that spirit, Conoco's Midland division has developed and implemented a number of best practices or initiatives. Some are very basic and almost common sense, while others are more complex.

Surface/Groundwater Protection

A best practice task force of engineers and operating personnel in Midland evaluated two fields that had numerous leaks. The best practice guidelines they developed improved environmental performance, and significantly reduced leakage.

Extensive leak investigations on all discharges of more than 50 barrels, including videos and formal reports, provided such data as location, type of discharge, and cause. With detailed leak reports, the team was able to zero in on causes, not symptoms, and develop engineering and operating guidelines to prevent future discharges and minimize waste cleanup. Although the initial process was actually reactive and not pro-active, it provided the impetus for expanding Conoco's best practices concepts.

The study developed guidelines for fiberglass pipe selection and installation, tank installations–new or relocated–and coated-steel line specifications and installations. And while the guidelines generally adhere to American Petroleum Institute, American Society of Mechanical Engineers, and other related recommended practices, they are written in a much more concise manner for easy reference by engineers and operations personnel.

Best practices were developed for selectively replacing gathering lines, including 6-year-old steel lines that had cathodic protection interference, fiberglass and steel lines that were improperly designed and had improper makeup, and cement-lined pipe with improper joint closure.

The effort was cost effective. Savings from the leak investigation and cleanup will pay for the investment, and the potential cost of future liabilities has been reduced.

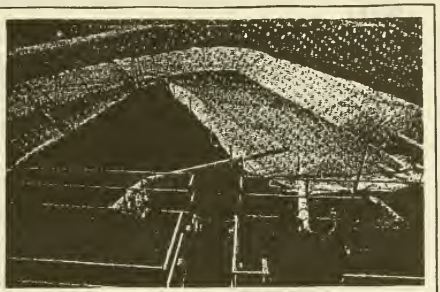
Sumps And Pits

Conoco's environmental best practice in a sump renovation program resulted in the elimination of more than 50 percent (more than 300) of the Midland division's sumps. Remaining sumps were either upgraded to double-lined, below-ground sumps with visual leak detection, or were replaced with above-ground sumps.

This initiative was originated to ensure sumps could not be considered as underground storage tanks. However, it led to the consolidation of tank batteries, resulting in further reduction of operational expenses.

Another initiative in soil/groundwater protection was an innovative design for a drilling reserve pit. The new design not only reduces the pit's environmental impact, but also provides substantial cost savings. The inverted V-shape reserve pit, called a "Stealth" or "V" pit, provides some major advantages.

The "V" pit design results in an average cost savings of $10,000. It is 60 percent less expensive to build and operate than a conventional pit, and with 25 percent less surface area, reclamation is quicker and easier. Only 20 hours are



Conoco's "V" pit design results in an average cost savings of $10,000. It is 60 percent less expensive to build and operate than a conventional pit.

required for construction versus 34 hours for conventional pits. In addition, solids settling is enhanced with a 55 percent reduction of solids.

Conoco's program to help minimize potential surface contamination is evaluating designs to provide secondary containment for chemical storage with a goal of eliminating chemical leaks.

One resulting solution is a "barbecue pit"-type enclosure to protect areas around chemical pump fittings, where most chemical leaks occur. For the price of one, often expensive, chemical cleanup, several chemical containment enclosures can be built.

Propane Converted Trucks

In 1990-91, Conoco's Midland division converted all 200 of its Permian Basin pickup trucks to dual fuel systems. The average installation cost of $1,150 was offset by a reduction of 5.4 cents per mile in operating costs. Average payout for the conversion was 12 months per vehicle. Employees report no change in post-conversion performance.

With more than 5 million miles a year successfully logged in the Permian Basin, the program has been expanded to Conoco's entire exploration and production division.

These best practices, and the need for developing many more, point out the ever-critical role of engineering in addressing environmental questions. Successful integration of this environmental perspective within the industry's planning and design process requires awareness.

For environmental initiatives to succeed, or even get started, petroleum engineers must be actively engaged in learning about and applying environmental best practices. ❑

ROBERT D. KIKER *is director of safety, health, environmental and regulatory affairs for Conoco's Midland Division. He has a B.S. in petroleum engineering from Texas Tech University, and has been a member of the Society of Petroleum Engineers since 1957.*

Environmental 'Best Practices'

Vapor Recovery Uses Produced Water

By W.G. "Bill" Webb

MIDLAND, TX.–High volumes of produced water and low volumes of hydrocarbon tank vapors characterize many hundreds of West Texas production facilities. Both situations require proper handling procedures, and in particular, vapor emissions have come under increasingly stringent state and federal controls.

The need to resolve these disposal situations, and the contrast between the opposite extremes of water and gas volumes, inspired production personnel in Conoco's Midland Division to consider whether the two problems might have a common resolution. What resulted was a simple, cost-effective system that uses produced water and a jet pump to recover low-volume vapors.

The "Vapor Jet" system was encouraged and developed through a "Best Practices" program instituted by the Midland Division. Derived from Conoco's environmental precept of "sustainable development on a cost effective basis," the Best Practices program encourages awareness and application of successful environmental solutions which, in effect, challenge petroleum engineers to also be environmental engineers.

Traditional vapor recovery systems have generally had a bad reputation among production facility personnel. The compressor-based systems most commonly installed in larger, higher vapor-volume facilities, are often looked on as high-maintenance items that have little to do with the facility's primary operations.

For smaller production facilities, where vapor volumes are below the 20,000-25,000 cubic feet a day minimum efficiency range of traditional vapor recovery systems, there has not been an economic alternative for recovery. As a result, hydrocarbon tank vapors from these low-volume facilities have usually been vented or flared.

The Vapor Jet, however, has no minimum volume limitation. And in the face of the Clean Air Act Amendments of 1990 and resulting regulation of air emissions (see accompanying sidebar), this low-volume capability is of critical importance to many small facilities. In some cases, it may be the difference between continued operations and shutting down the facility.

Even modest amounts of vented vapor can make a significant contribution to overall emissions. In the Permian Basin, for instance, total emissions of 25 tons of volatile organic carbons per year (the triggering level for air emission permitting) could be reached by venting less than 5 Mcf/d of the area's natural gas.

Design And Operation

The patented Vapor Jet system employs a jet pump, also known as a venturi, eductor or ejector, to entrain low-pressure tank vapors in a stream of high-velocity production water (see Figures 1 and 2).

Hydrocarbon vapors, held at near-atmospheric pressure in the storage tanks, are piped to the jet pump where they are entrained in the water stream. The water with entrained vapors is discharged from the jet pump and piped to the production facility's low-pressure separation system.

Vapors are separated and sold with other lease gas, or injected in a waterflood or water disposal system. Produced water is returned to storage for further degassing and re-use, disposal or waterflood injection.

The Vapor Jet's simple design and operation help keep capital and operational expenses to a minimum–a critical factor at marginal production facilities. In West Texas applications (where vapor volumes range from as little as 5 Mcf/d to 25 Mcf/d), the system has reduced Conoco's costs by one-half to three-fourths over conventional vapor recovery unit configurations.

The equipment, basically a jet pump, centrifugal pump and drive motor, and piping to transport the produced water, is all inexpensive, off-the-shelf equipment. Hardware for a two-four tank facility runs $5,000-$6,000. Installation costs will generally add an additional $5,000-$10,000 to the total cost. In contrast, the component costs alone for a small vapor recovery unit (rated for 30 Mcf/d at 25 psi discharge in sour service) ranges from $10,000 to $13,000.

The main operating expense for the Vapor Jet is the cost of electrical power; maintenance expenses are minimal. In 20 applications by the Midland Division, Vapor Jet maintenance costs have been as little as $250 a year. A "major maintenance" allowance of only $500 is scheduled every five years.

TABLE 1

Vapor Jet As Process Enhancement

	Case 1 System without Vapor Jet	Case 2 System with Vapor Jet as Control	Case 3 System with Vapor Jet as Enhancement
Actual HAP Emissions, TPY	20	2	2
Potential to Emit, TPY	20	20	2
Major Source	Yes	Yes	No
Title III MACT Applies	Yes	Yes	No
Title V Permit Applies	Yes	Yes	No

By contrast, operation of conventional vapor recovery units (in addition to electrical costs), includes the costs of lubricating oil, routine maintenance, and periodic compressor overhauls. Based on the operation of 30 vapor recovery units (30 Mcf/d capacity) in West Texas, Conoco's average yearly maintenance costs per unit are $3,600-$4,200. In addition, a $2,500 compressor overhaul every five years is generally required.

Impacts Of CAA

Another important factor in the economics of vapor recovery is the impact of regulation. The Clean Air Act Amendments of 1990 and ensuing state air emission standards now regulate and enforce by fee and fine, air emissions from oil production facilities. Hydrocarbon tank vapors are often large contributors to a facility's total emissions.

As a result, today's operational economics must include the expense of recovering tank vapors. The cost of regulatory compliance with storage tank emissions standards has become an important factor in a lease's profitability–and frequently in its continued operation.

In dealing with production facility emissions, operators must be aware that the difference between classifying the Vapor Jet system as a process enhancement, or as a control technology, could be significant in establishing a facility's potential to emit, as used in the definition of "major source" under the air toxics and permit provisions of the CAA amendments.

The CAA's definition of a major source means any stationary source "that emits or has the potential to emit not considering control . . . 10 tons per year or more of any hazardous air pollutant, or 25 tons per year or more of any combination of hazardous air pollutants."

Conoco believes that equipment modifications, such as the Vapor Jet system, which is designed to maximize the amount of resalable products (i.e. economically justified on these merits), should not be construed as air pollution controls, even though emissions to the environment may be reduced. This interpretation, if accepted by the regulators, will eliminate the need for permitting under Title V and use of maximum achievable control technology (MACT) under Title III of the CAA.

Take for example, a system that is emitting 20 tons a year (TPY) of a hazardous air pollutant (such as benzene), as illustrated in Case 1 in Table 1. Without any type of vapor recovery system, the

FIGURE 1

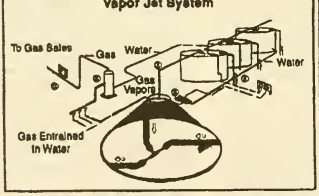
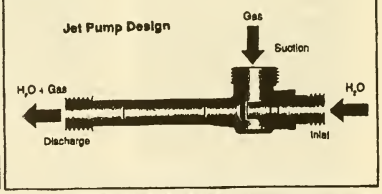


FIGURE 2



LEFT: Stored production water, pumped through a jet pump, entrains low-volume vapor from crude storage tanks and carries it to the system's low-pressure separation system. RIGHT: With no moving parts, the jet pump has little to break. The result is a low-cost, low-maintenance technology for recovering tank vapors.

actual emissions and "potential to emit" for that system is the same 20 TPY. It would be classified as a major source under the CAA, Title III MACT and Title V permits would apply to this facility.

In Case 2, the same system was fitted with the Vapor Jet system, which reduced its actual emissinn of the hazardous air pollutant to 2 TPY. Since the Vapor Jet system was classified as control technology, the potential to emit for the system remains 20 TPY, and it would still be defined as a major source, and be subject to Title III MACT and Title V permitting.

With the Vapor Jet system installed as a process enhancement to provide economic benefits (Case 3), the production facility's potential to emit would be the same as its actual emissions, 2 TPY, and the facility is no longer a major source.

Look For Innovations

The Vapor Jet system, like many of the environmentally oriented innovations developed by the Midland Division, resulted in large part from engineers first being aware of the situation, and then proactively looking for solutions.

When oil and gas engineers view environmental engineering as a jnb priority, the results can be very rewarding. In the ense of the Vapor Jet system, a simple combination of hardware and nvnilable resources lias resulted in a system that may ultimately allow the continued operation of hundreds of West Texas production facilities. ❐

W.G. "BILL" WEBB *is area production manager for Conoco's Midland Division. A 21-year Conoco employee, Webb has worked as an engineer and production supervisor in Louisiana, Oklahoma, Texas and Canada. He has a B.S. in petroleum engineering from Louisiana State University.*

Environmental 'Best Practices'

Recovered Products Pay Cost Of ARU

By Michael S. Choi

HOUSTON–Aromatic emissions from glycol dehydrators threaten production facilities with an added economic burden as operators face compliance with increasingly stringent state and federal nir quality standards. For many production facilities, these emissions may be the only source that exceeds regulatory limits.

But the impact of the Clean Air Act Amendments of 1990 and related state standards may be significantly lessened through the cost-effective utilization of a process enhancement developed by Conoco called an aromatics recovery unit (ARU).

As an enhancement to standard glycol dehydrator units (GDUs), the patented ARU recovers hydrocarbons that are normally vented along with water vapor to the atmosphere during glycol regeneration. Installed to maximize products recovery and profits from operations, this economics-driven ARU process enhancement can help establish much lower facility emissions in advance of regulatory control.

Most natural gas sale contracts limit water content to seven pounds or less per million standard cubic feet of gas. A variety of methods to dehydrate the gas are used to achieve these low water contents. Among the most popular is the desiccant, triethylene glycol (TEG).

In addition to having good water absorption characteristics, TEG has a high affinity for aromatic hydrocarbons. When used to dehydrate natural gas that contains aromatic compounds, TEG readily absorbs the aromatics along with the water vapor.

Aromatics and water are removed by heating the TEG stream. The vaporized water and hydrocarbons released by the glycol during this regeneration process are commonly piped to a sump, which collects a small amount of condensate. The majority of the aromatics, however, are vented to the atmosphere along with the water vapor.

Impact Of CAAA

While the GDU condensate that reaches the ground can contribute to soil and ground water contamination, the major point of concern centers on provisions of the Clean Air Act Amendments as they relate to venting aromatics to the atmosphere. Of the 189 hazardous air pollutants listed by the CAAA, the BTEX components of aromatic hydrocarbons (benzene, toluene, ethyl benzene and xylenes) and N-hexane appear to be the most troublesome for oil and gas producers. But not all dehydrator vents contain aromatic hydrocarbons. The amount of BTEX is dependent on their concentrations in the natural gas, and to a lesser degree, the operating conditions in the dehydrator.

When present, however, GDU aromatic emissions can make a significant contribution to a production facility's overall emission levels. A 1990 survey by the state of Louisiana which examined 191 GDUs that used TEG, indicated that an average 0.93 tons of BTEX a year are emitted for every million standard cubic feet a day of gas that is processed. And these averages obscure a wide range of emissions. Some GDUs can emit as much as three tons-four tons of BTEX a year per standard million cubic feet of daily gas production, while others emit considerably less.

Recognizing the potential air quality problem associated with GDUs, many companies have investigated–with varying degrees of success–ways to reduce or eliminate BTEX emissions. In November 1990, Conoco's Houston-based Production Technology Group put its first ARU in the field. Five units are now in operation, and the design has proven to be very cost-effective. The incremental cost of the first ARU, designed to accommodate the emissions from a high-pressure, 30 MMcf/d dehydrator, was $30,000. The value of recovered products was estimated to be $42,950 a year.

The recovered products included six barrels a day of condensate (valued at $20 a barrel) recovered in the condensate and glycol flash separators, and 26 Mcf/d of fuel gas valued at $1.30 an MMBtu. Payout for the ARU was calculated to be eight months, and the corresponding annual rate of return on investment was 147 percent.

Other potential economic benefits may also be derived from installation of an ARU. For example, Louisiana has initiated a fee of $100 a ton of benzene emissions over 260 pounds a year. Since it has been shown that the ARU virtually eliminates all hazardous air pollutant emissions, the fee would not apply to dehydrators with ARUs.

Design And Operation

The ARU is a very simple system from a process as well as a mechanical perspec-

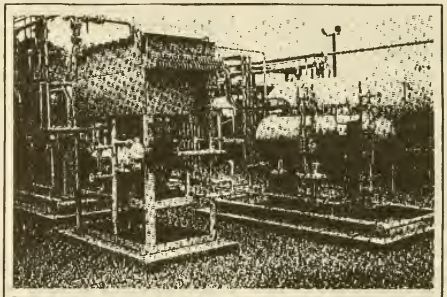
tive. Easy to operate and maintain, the unit's operation is virtually transparent. The equipment is standard oil field issue familiar to most operation personnel. components are relatively small and simply instrumented, and the unit can be used for new GDUs or as a retrofit for existing units.

The process consists of condensation of the still's overhead vapors, separation of the respective phases, and incineration of the non-condensable vapor in a separate burner located within the fire tube of the reboiler. The BTEX-rich hydrocarbon liquid recovered in the condensate separator may be very stable, and can often be pumped straight to the stock tank for sale.

The solubility of aromatic hydrocarbons in water, especially benzene, is very high, so care must be taken in water disposal. Onshore, it may be injected into a disposal well. Offshore, the water may be blended with platform-produced water for disposal.

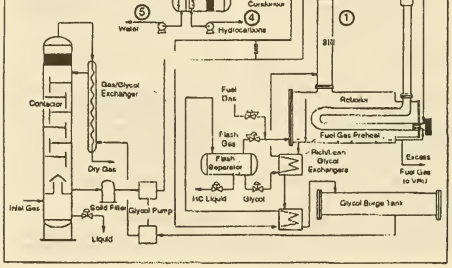
To reduce the amount of non-condensable vapor that must be incinerated, a glycol flash separator should also be incorporated as a part of the ARU enhancement. The flash separator also prevents excessive hydrocarbon liquid carry-over in the rich glycol from reaching the reboiler.

Figure 1 illustrates the flow of glycol through a GDU fitted with an aromatics recovery unit. On exiting the vertical still of the GDU regenerator (1), vapors that would normally flow unimpeded into the atmosphere enter the ARU. There they are further cooled and partially liquefied in a condenser (2). The condensed water and aromatic hydrocarbon steam, along with some non-condensable vapors, flows to a small three-phase separator (3). The hydrocarbon liquids, composed primarily of aromatics, are pumped to a hydrocarbon treating vessel (4). Water is pumped to the saltwater disposal system (5), and any remaining non-condensable vapors are piped (6) to the reboiler for incineration.



The aromatic recovery unit (ARU) enhances the operation of standard glycol dehydrators by maximizing emissions recovery and profits, while eliminating venting to the atmosphere.

FIGURE 1 Glycol Dehydrator With Aromatic Recovery Unit



Additional Benefits

In addition to cost-effective recovery of aromatic hydrocarbon emissions, field operations have shown that the ARU also recovers heavier, paraffinic hydrocarbons.

Life of the reboiler fire tube is improved because hydrocarbon condensate captured in the flash separator is recovered before entering the reboiler, reducing the possibility of coking and hot spots.

The ARU also improves the glycol regeneration process by inducing a slight vacuum to the reboiler system. It is important to have little to no back pressure on the regenerator for two reasons:

GDU regenerator vessels are built to operate at nearly atmospheric pressures. It has been reported that some companies experienced rupture of the reboiler shell when other extraction methods were attempted that placed back pressure on the regenerator.

Additional reboiler back pressure above atmospheric pressure raises the temperature required to regenerate TEG to the desired purity. A temperature of 374 degrees F (190 degrees C) is needed to achieve 99 percent pure TEG at atmospheric pressure. Any back pressure results in lower quality TEG at the same temperature. Raising the working temperature compensates for the higher pressures, but pushes the TEG toward its degradation temperature of 420 degrees F.

Looking at traditional oil and gas operations with an environmental eye is of

critical importance to the industry. As Conoco's Robert Kiker, Midland Division director of safety, health, environmental and regulatory affairs, noted in part one of this series, "The 'way we have always done it' is not a satisfactory response to minimizing the industry's environmental impact."

Refinements and process enhancements such as the aromatics recovery unit, the Vapor Jet system, and a host of other innovations are indicative of what a proactive environmental approach can produce. Through a growing awareness of environmental considerations, petroleum engineers begin to incorporate environmental solutions as a natural part of the engineering process.

With such enhancements, the industry limits its impact on the environment, reduces its liabilities, and often not only lowers expenses, but also raises revenues. □

MICHAEL S. CHOI *is a senior staff engineer with Conoco in Houston where he is involved with facility engineering. His professional background includes design and operation of gas processing facilities, liquefied natural gas, sour gas treatment and sulfur recovery, and oil and gas production facilities. Choi has a B.S. in chemical engineering from the University of Southern California.*

ADVANCEMENTS IN THE USE OF MAGNETICS FOR CONTROLLING DEPOSITS AND BS&W IN OIL WELLS

John D. Corney, Mag-Well, Inc.

Presented at the April, 1993 Short Course, Lubbock, Tex.

ABSTRACT

Deposits of paraffin wax, asphaltene, mineral scale and the water component of BS&W (basic sediments and water) in oil wells have cost producers millions of dollars in chemical, thermal and mechanical treatments, and in lost production. In some cases, traditional treatment methods have reduced the ability of the wells to produce to their potential.

Previous treatment methods such as biological, galvanic, and magnetic devices were minimal and were limited to a few geographical areas. Ceramic or alnico magnets used in the past have been replaced by the introduction of new high energy product magnetic material, which is eight to thirty times more powerful.

This new magnetic material has allowed more effective circuit design in magnetic fluid conditioners (MFCs). Performance of properly designed MFCs has greatly increased, resulting in more effective control of the deposition of solids in oil wells and associated equipment.

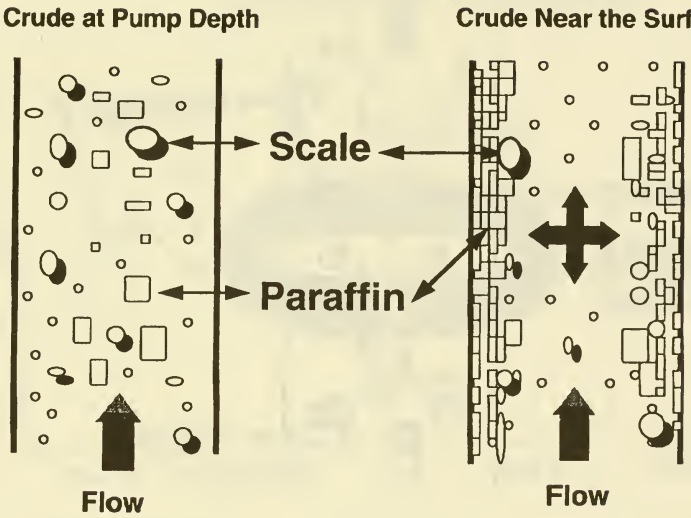
By directing crude oil and water through strong, permanent magnetic fields within a tool, the growth pattern of paraffin and scale crystals is altered, inhibiting the build up of solids in the well and production equipment. The MFC does not require any external power and does not need to regenerate the internal magnets. The permanent magnetic material in the magnetic circuits does not give up its strength to the system. The energy source comes from a slight pressure drop which occurs when the fluids pass through the venturi of the tool.

The secret to the successful application of the MFC is the accurate determination of the environment in a given well. If the well fits into parameters treatable with magnetics, an MFC can be properly engineered for that specific well.

The insert model for a pumping well, constructed of 300 series stainless steel, attaches to the bottom of the pump and fits through the seating nipple, requiring only the rods and pump to be pulled to install the tool. The insert model for flowing and gas lifts wells is set in the seating nipple or on a collar lock via wireline. Tubing tools thread onto the tubing string of high volume flowing wells or below tubing or ESP pumps. Surface tools fit in line and are sized to match production rates and transmission line pressure.

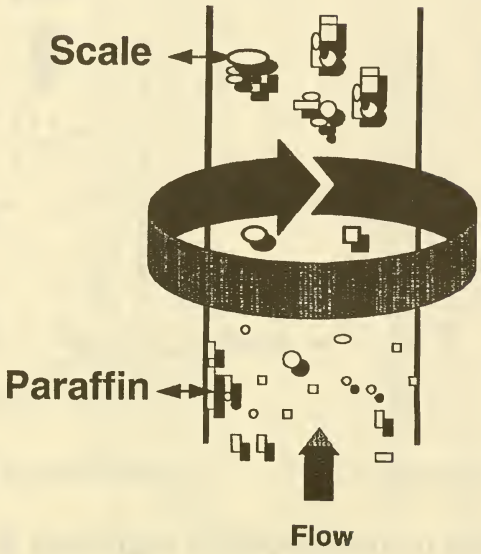
MFC installations are environmentally safe and cost effective without the potential damage to the formation and production equipment associated with chemical, thermal or mechanical methods.

Scale & Paraffin Deposition in Producing Wells



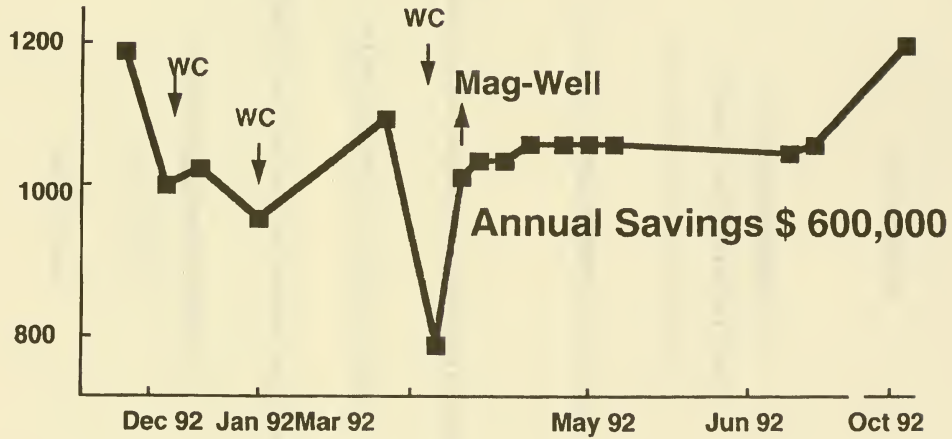
Mag-Well Inc.

Mag-Well's Advanced Technologies



Magnetic Fluid Conditioner

Shell- South China Sea Offshore Platform



WC = Wax Cut

Mag-Well Inc.

TESTIMONY OF

JAMES F. FOX

PHILLIPS PETROLEUM COMPANY

BEFORE THE

SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO,

AND THE OUTER CONTINENTAL SHELF

COMMITTEE ON MERCHANT MARINE AND FISHERIES

U.S. HOUSE OF REPRESENTATIVES

MAY 19, 1994

SUBSALT EXPLORATION IN

THE OFFSHORE GULF OF MEXICO:

UTILIZATION OF THE LATEST TECHNOLOGIES

By: J. F. Fox

May 19, 1994

SUBSALT EXPLORATION IN THE OFFSHORE GULF OF MEXICO: UTILIZATION OF THE LATEST TECHNOLOGIES

INTRODUCTION:

Thank you, Mr. Chairman, members of the Subcommittee. My name is James Fox. I am the Geoscience Director for Worldwide Exploration of Phillips Petroleum Company, headquartered in Bartlesville Oklahoma.

Phillips is an integrated oil company and is involved in all aspects of the petroleum business, from exploration and production to refining, marketing and transportation. We also have a sizable petrochemicals business.

Phillips maintains a strong presence in the United States with over half of our worldwide production coming from North America. We have a significant presence in Alaska, California, Louisiana and Texas, among other states as well as in the Gulf of Mexico. We are the industry leader in the gathering and processing of natural gas in the United States and in the production of natural gas liquids.

One of the reasons we are here today is the result of the strong emphasis that Phillips has traditionally placed on research and development. The development of new technology is a particular niche where our company has enjoyed tremendous success. Phillips appreciates the invitation from the Committee to testify on a subject that builds on the strengths just mentioned -- the application of new technologies developed by our R&D groups to support the search for new reserves in the United States.

SUBSALT EXPLORATION IN THE OFFSHORE GULF OF MEXICO
May 19, 1994

BACKGROUND:

The offshore search for oil and gas in the Gulf of Mexico first began in the 1940's. In fact, Phillips was the first company to drill a well out-of-sight of land in the mid-1940's. Since that time, the industry has drilled over 30,000 wells and discovered and produced over 20 billion barrels of oil equivalent from the Gulf of Mexico. Today, the Gulf is the center of a major economic stimulus for our economy, supplying a major portion of our country's daily oil and gas needs.

By the mid-1980's, conventional wisdom and existing technology had convinced the industry that the Gulf Coast Basin was mature and had been thoroughly explored, and that production, which had peaked in the early 1970's, would continue its steady decline. It was at this time that the potential for a large, new exploration trend was theorized -- the subsalt.

THE SUBSALT PLAY:

The recent discovery of significant reserves in subsalt formations in the Gulf has generated a good deal of enthusiasm within the oil and gas industry. The prospects for future subsalt discoveries may breathe significant new life into the Gulf in terms of additional potential oil and gas reserves. Until recently, the prospect for resource discoveries in these formations was not considered.

SUBSALT EXPLORATION IN THE OFFSHORE GULF OF MEXICO
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A great deal of the production in the offshore Gulf of Mexico is found around the sides and over the top of salt domes. Salt domes are large cylindrical fingers of salt that rise vertically through the surrounding sediment due to buoyancy (Attachment A). Salt domes are the most common type of salt feature found worldwide and geologists generally believed that most of the salt features found in the Gulf of Mexico were typical domes.

Three key events in the 1980's made us change our minds about the way salt behaves in certain parts of the Gulf of Mexico. First, several wells were drilled through salt and back into sediment, indicating that the salt was not a typical dome. Second, the use of three-dimensional seismic allowed us a first look at the true geometry and shape of the salt. And third, a new technology called "depth migration" allowed the earth scientists to actually see the subsurface geology as it really was. These technologies of three-dimensional seismic and depth migration, which I will discuss shortly, gave us a new view on the mechanics of salt movement in the subsurface.

The data showed, and we were able to substantiate in laboratory models, that ancient sedimentation from the Mississippi River was so powerful that it pushed the salt sideways instead of letting it grow vertically as a typical dome. As the salt moved vertically, it covered thick sands that would become future oil reservoirs. Because salt is impermeable, the lateral salt sheets can provide an excellent seal for trapping hydrocarbons. Finally, because these lateral salt sheets are extensive, the amount of hydrocarbons trapped below the salt, or "subsalt," can be quite large (Attachment B).

SUBSALT EXPLORATION IN THE OFFSHORE GULF OF MEXICO
May 19, 1994

HYDROCARBON POTENTIAL:

In September 1993, Phillips Petroleum Company and its partners announced an oil discovery located in the Gulf of Mexico, 80 miles offshore Louisiana on Federal Lease OCS-G-12008. This discovery, named Mahogany, was drilled to a total depth of 16,500 feet in 370 feet of water on the shelf. We are currently drilling another well to determine the size of the accumulation, but estimate that the accumulation could have reserves of approximately 100 million barrels of oil equivalent (Attachment C).

Phillips is currently drilling two additional subsalt prospects with our partner, Anadarko, and anticipates drilling another two prospects this year. We will drill several additional prospects in 1995. We are also using the same depth migration technology to drill wells in existing fields, bringing new life to fields that have been producing for almost 50 years. We have already drilled three successful wells in these old fields, and we are poised to conduct additional drilling.

TECHNOLOGY:

But what is the technology that has allowed us to pursue the subsalt play? The technology is two-fold -- three-dimensional seismic data and the ability to depth migrate this data.

Geoscientists use seismic data, data collected using sound waves, to generate echoes off the rocks below the surface to determine the geology of the area and to determine the best location to drill the wells. For many years, the technique was to collect two-dimensional seismic along lines

spaced about a quarter of a mile apart. Using this seismic, geophysicists would make a map of what they thought was in the empty spaces between the lines. The technique worked well when searching for large, simple accumulations of oil, but became more risky as the geology grew more complex.

The advent of three-dimensional seismic helped lessen this risk. The technology was sufficient by the late 1980's to economically acquire three-dimensional seismic across large areas of the Gulf of Mexico. This data allowed the geoscientists to see the earth not only along vertical profiles, but also horizontally. Three-dimensional seismic also served another vital purpose: it allowed geophysicists to display their data so other professionals, including geologists and engineers, could visualize the features that they were seeing. Three-dimensional seismic became the communication tool that allowed "integrated teams" (professionals with different disciplines) to solve problems never before possible.

But three-dimensional seismic, alone, was not sufficient to unlock the subsalt domain. As stated earlier, most of what we know about the subsurface comes from seismic data, a means of directly measuring the TIME it takes for a soundwave to travel through the earth and be echoed back to the surface. To see a true picture of the earth, we need to see in depth, not time. Just as looking through a drinking glass distorts the image on the other side, the subsurface rock layers distort the time picture seen by the seismic due to varying velocities in the subsurface.

To correct this distortion, our researchers developed a way to correctly determine the time-depth relationships. It requires a supercomputer to perform the complex repetition process involving massive number crunching; an integrated team of geologists, geophysicists, mathematicians and computer programmers to develop the models; and a graphics workstation to allow the team to visualize the results at every step of the process.

The results allow us to see the geology in the subsalt more clearly, something that we have not been able to do in the past. This has lowered our exploration risks considerably at a time when our industry is facing budget constraints. As you can see, it took several technologies coming together at the same time to allow this to happen -- three-dimensional seismic, new depth migration algorithms, and a supercomputer powerful enough to run the program (Attachment D).

IMPACT ON INDUSTRY:

The success of Phillips' Mahogany well has had a significant impact on, both, our company and the industry. The latest OCS lease sale was the most active sale held in several years, with many bids in the 5-40 million dollar range. The interest in subsalt was a key factor in that sale.

The Mahogany announcement, coupled with some deepwater developments, has also increased the demand for drilling rigs in the Gulf of Mexico. Several rigs have returned from overseas locations, bringing new jobs back to the Gulf Coast oil patch. There has also been other ripple effects, such as increases in the geophysical contracting industry as more companies want depth migrated three-dimensional seismic surveys.

SUBSALT AND THE ENVIRONMENT:

A key additional attraction of the subsalt potential is its minimal future environmental impact. The current area of subsalt interest lies in an area well known to the industry and to government agencies with jurisdiction on the OCS. The region has been the subject of intensive studies and lies in close proximity to an existing infrastructure that will allow for easy transportation via pipelines. Unlike frontier areas, future developments in this region will lend themselves to minimal new infrastructure requirements; and, therefore, minimal environmental impact.

While we are excited about the emerging subsalt technology, it does not come cheap. Supercomputer and three-dimensional seismic data require a large investment not found in drilling conventional wells. A typical well drilled in the subsalt costs $12-15 million -- two to three times that of a typical non-subsalt well drilled in the same water depth. Drilling below the salt also poses additional difficulties that can result in mechanical failures and add millions of dollars to the cost.

Despite the promise that new technologies are making to cut the risks involved in the search for oil and natural gas resources, our business still holds significant risks. Every successful discovery is accompanied by several dry holes, making exploration and production, perhaps, the most expensive business in the world.

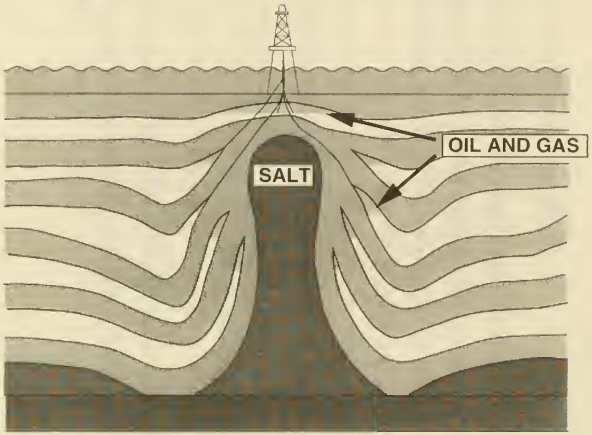
CONCLUSION:

There are many challenges yet to be met in subsalt exploration. Phillips is still confirming the size of Mahogany prior to a final commitment to develop the field, but we are excited about the exploration results, to date. Phillips is confident that we will continue to improve the technologies that will allow us to be successful.

In addition to my prepared text, Mr. Chairman, Phillips has made available to each Committee Member, and the Subcommittee Staff, a brief nine minute video tape that details the subsalt activity in the Gulf and the related technology.

Again, Phillips thanks the Subcommittee for the opportunity to provide information on subsalt exploration and technology. I would be happy to respond to any questions that you may have.

TYPICAL SALT DOME – GULF OF MEXICO



Attachment A

SUB SALT PLAY CONCEPT
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NEW ORLEANS
MAHOGANY
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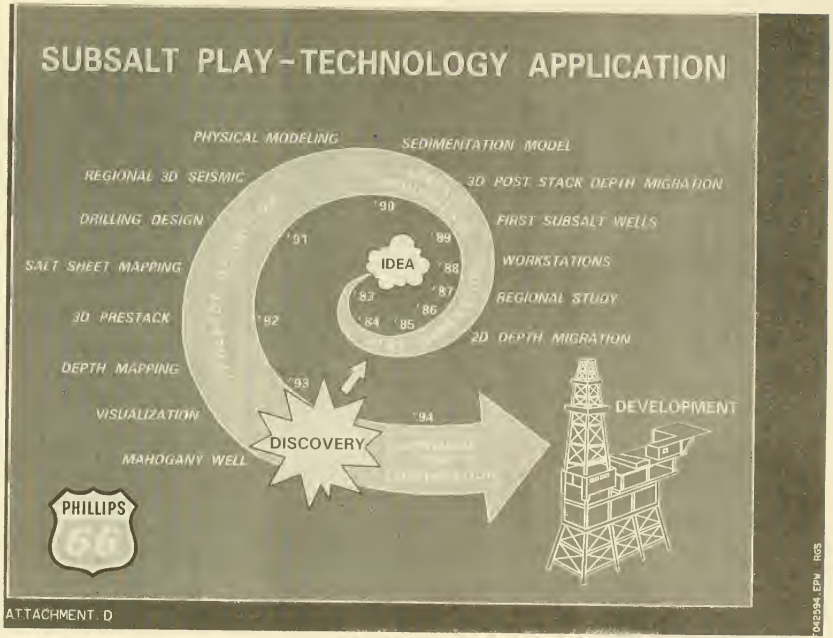
SUBSALT PLAY - TECHNOLOGY APPLICATION
PHYSICAL MODELING
SEDIMENTATION MODEL
REGIONAL 3D SEISMIC
3D POST STACK DEPTH MIGRATION
DRILLING DESIGN
FIRST SUBSALT WELLS
SALT SHEET MAPPING
WORKSTATIONS
3D PRESTACK
REGIONAL STUDY
DEPTH MAPPING
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May 16, 1994

BACKGROUND MEMORANDUM

TO: Members, Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf

FROM: Subcommittee Staff

SUBJ: State of Research and Development in Offshore Technology

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On Thursday, May 19, 1994, the Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf will hold a hearing on the state of research and development in offshore technology for the oil and gas industry. The hearing will convene at 1:30PM in room 1334, Longworth House Office Building.

Witnesses will include representatives from the Minerals Management Service, the National Ocean Industries Association, the International Association of Drilling Contractors, Phillips Petroleum Company, and the Geochemical and Environmental Research Group (GERG) of Texas A&M University.

BACKGROUND

Trends in Offshore Technology

The first offshore lease sale was held in 1945. The transition to water challenged the industry to master offshore technology over the next two decades. The first platform constructed out of sight of land (Ship Shoal area off Louisiana's coast) was constructed in 1947. By 1950, drillers had a 25 percent success rate on wildcat wells drilled offshore as compared to a 10 percent success rate onshore. The expansion of the offshore industry over the next ten years was a direct result of rapidly advancing technology in offshore platform and vessel design. Wood was replaced with steel. The use of steel enabled the development

of larger, longer lasting drilling platforms. Such platforms included the submersibles which were drilling rigs mounted on the decks of barges that allowed drillers to work in greater depths of water. After drilling depths reached 175 feet, larger submersibles became too expensive and the alternative was the development of the semisubmersibles and "jackup" drilling units, which had pilings or legs attached to the hull of a floating dock. The development of the drillship allowed drilling rigs to be permanently mounted on vessels which could be moved from well to well in a matter of days.

By the mid 1950s the oil and gas industry had produced too much oil and an oversupply developed, causing the price of crude oil to drop to the level of two to three dollars a barrel. This marked a major recession in the oil and gas industry. At this same time, most of the offshore areas with hydrocarbon reservoirs had been identified, and industry had made full use of the extent of geophysical knowledge.

Seismic velocity technology (use of wave equations to determine mechanical properties of the earth's crust) significantly boosted the ability of oil companies to locate reserves during the 1970s. Bright spot seismic technology was developed in 1972, and seismic data streamer tracking was introduced in 1976. By 1978, computer technology had advanced enough to convert seismic velocity data into geological information for modeling. The new technology coupled with the impact of the 1973 and 1979 Mideast oil embargoes revitalized the oil industry and made it economically possible to look for reserves beyond the edge of the continental shelf.

Technology kept pace with the industry, and by 1983, drilling depths exceeded 1,000 feet. Tension-leg and guyed tower platforms (tendons of steel pipe designed to support a floating well production system in a manner similar to fixed platforms in shallow water) were tested and subsea wells serviced by floating production systems increased around the world. Subsea systems are designed to be installed and maintained by diverless systems called remotely operated vehicles.

Trends in oil and gas production and consumption

By 1980, the size of new discoveries in the Gulf began to shrink and most of the new discoveries were gas rather than oil. With falling oil prices, the industry began looking further offshore into deeper waters. Major oil companies began looking at the world-wide picture and began thinking about moving overseas (North Sea, West Africa, and Southeast Asia). As a result, independent operators in the U.S. Gulf were drilling more wells than the major oil companies by 1988. Platform removals in the Gulf of Mexico exceeded installations for the first time in 1989. By 1992, the U.S. majors' international budgets exceeded their U.S. allocations. These new opportunities abroad have brought about the development and utilization of new technologies overseas.

During 1994, crude oil production is estimated to decrease by three percent, natural gas production is expected to increase by two percent. Aggregate U.S. production of crude oil and natural gas is expected to decline less than one percent in 1994. This is a trend that analysts expect to continue.

During 1994, consumption of petroleum will increase two to three percent and natural gas three to four percent. Increased consumption is expected to continue over the near future. The increasing consumption trends will lead to increased imports and the need to renew depleted gas storage levels.

Domestic crude oil production is expected to continue its long-term decline. This decline has been brought about in part by increasing development costs, decreasing oil reserves, and better opportunities abroad. Operators have had to choose between investing in deep-water programs or continuing drilling higher up on the continental shelf in existing fields.

Natural gas is now more important to the U.S. oil and gas industry than it has ever been. More than 50 percent of U.S wellhead revenues came from natural gas in 1993. Based on predictions of a continuing decline in oil prices and a continuing increase in natural gas prices over the next two years; drilling for gas in the U.S. will increase in the next few years.

Recent Developments in Offshore Technology

Late in 1993, the oil and gas industry in the Gulf of Mexico began to experience some rejuvenation. Production in the U.S. Gulf of Mexico is only three percent of the world's offshore crude oil production, but is 28 percent of the world's offshore gas production. The increase in U.S. energy consumption and the cost of doing business at home has kept the ocean industries looking for more efficient and economical ways of doing business. Three major issues that will influence the health and future opportunities for companies in the offshore industry are: aging equipment fleets, oil company economics, and technology. Technology plays a key role in revitalizing and maintaining the domestic industry. Technology can reduce operating costs and operating risks thereby increasing efficiency. Currently, technological developments are increasing in the areas of exploration (three dimensional seismic and subsurface imaging), drilling (extended reach, horizontal, and slimhole), and development (deepwater drilling, subsea completions, multiphase flow). A number of new drilling and development technologies are anticipated in the near future.

Subsalt Imaging and Prospecting

Salt tables exist in many forms throughout the Gulf of Mexico including tongues, walls, and pillows. Salt acts as an opaque lens through which two-dimensional seismic rays become distorted.

Geophysicists knew in theory how to look below salt tables 20 years ago but the technology had not been developed. The first successful subsalt imaging and discovery occurred in 1993. Phillips's Mahogany Field discovery last year, in the Gulf of Mexico, showed that the technology is now available to view direct hydrocarbon indicators through salt domes. Until very recently seismic exploration beneath salt tables was considered too expensive and a waste of time. However, over the past three years three-dimensional seismic data acquisition techniques have been perfected at the same time computer power has been elevated to a level capable of processing the data rapidly and accurately. While the potential for processing technology is becoming well defined, its use is not in routine production in the offshore industry and it is very expensive. In the Gulf of Mexico, salt tables cover approximately 36,000 square miles or approximately 60 percent of the Gulf floor. The large area of salt domes indicates that there is possibly a significant reserve potential and the ability to use existing infrastructure in the Gulf of Mexico.

Three-Dimensional (3D) Seismic Re-surveys

Several major operators (Phillips, Amoco, Oryx, Shell, Exxon, and Mobil) are beginning to base their site selection and drilling on the new three-dimensional data acquired with the newly developed computer technology. Independent oil companies, such as Murphy Exploration and Production Company, have also adopted the 3D approach. Operators have been reshooting large areas (previously surveyed with two-dimensional seismic ray paths) around proven acreage with three-dimensional seismic surveys and are coming up with new discoveries. Reservoirs can be accessed with existing boreholes using existing platforms. Up to the present, three-dimensional seismic resurveys have involved reduced risk and increased confidence in drilling. Drilling success ratios as high as 90% (Murphy) and 70% (Exxon) have been achieved and this has allowed operators to reduce their finding costs. Operations thus far have been in the shelf areas off central and western Louisiana, but the trend is spreading to the west and the south in the Gulf of Mexico. The success of three dimensional seismic data in rejuvenating and expanding existing fields is now well documented.

Blowout/Well Control Technology

Well control technology, developed to prevent and contain blowouts at the well, continues to advance. In addition to the advances in technology new applications are being discovered. Some of these practical applications include precision directional drilling and plugging techniques, and detection of subsurface well casing strings in the repair of wells previously considered impossible to fix for economic reasons.

Mud-to-Cement Conversion

Shell has successfully applied the mud-to-cement conversion technology in its record breaking deep-water tension leg platform, Auger. In this technology, ground up and granulated blast furnace slag (a calcium silicate byproduct of iron-making process) and alkaline activators are added to drilling muds to form a cement slurry (called "slag-mix" by Shell). The cement slurry is then used for all cementing operations. When wells are drilled, casings of increasing diameter are placed in the drilled hole to form a wall. Cementing the casings increases well integrity, reducing the damage which may occur during production and minimize fluid (gas) migration which can cause pressure buildup below the subsea well head. The mix is cost effective, and can reduce mud disposal costs in environmentally sensitive areas and zero-discharge areas because the mud is used as the base for the cement instead of being disposed or discarded.

ISSUES

1) What are the implications of new technologies for improvement in the Gulf of Mexico?

2) What are the implications of new technologies on the current regulatory regime?

3) What are the impacts of the current regulatory regime on the use of new technologies?

4) What are the implications of these new technologies on deep-water exploration?

5) Can these new technologies be useful both offshore and onshore?

6) Are these technologies beneficial, available, and affordable to independent operators in the Gulf of Mexico? What effect will these technologies have on the mix of major and independent operators in the Gulf of Mexico?

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Washington, DC 20240

JUN 30 1994

Honorable Gerry Studds
Chairman, Committee on Merchant
Marine and Fisheries
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

We are pleased to enclose responses to questions submitted to the Minerals Management Service as followup to the May 19, 1994, hearing on the state of research and development in offshore technology.

Thank you for the opportunity to provide this material to the Committee. If you have any further questions or need additional information, please let us know.

Sincerely,

Tom Fry
Director

Enclosure

cc: Honorable Jack Fields
Ranking Minority Member
Committee on Merchant Marine
and Fisheries
House of Representatives

Honorable Solomon Ortiz
Chairman, Subcommittee on
Oceanography, Gulf of Mexico,
and the Outer Continental Shelf
House of Representatives

Honorable Curt Weldon
Ranking Minority Member
Subcommittee on Oceanography,
Gulf of Mexico, and the Outer
Continental Shelf
House of Representatives

Question 1: How is the MMS using new three-dimensional (3-D) seismic data processing technology in its resource evaluation and assessment and in determining fair-market value under the Outer Continental Shelf Lands Act?

Answer: Through its Geologic Interpretive Tools (GIT) pilot project in the Gulf of Mexico (GOM), MMS is now able to implement the use of workstations and associated software that are essential to take full advantage of the 3-D seismic information. While MMS has been behind industry in the capability and implementation of 3-D seismic information, the GIT pilot project is a firm beginning for the Bureau's efforts in this area over the years to come.

Actual implementation for tract evaluation purposes began with the evaluation of bids for several tracts in portions of the Viosca Knoll and Mississippi Canyon areas of the GOM offered in Sale 147 in March 1994 which had been rejected by MMS in previous sales. Broader applications will be used over the next few years to support the resource assessment and resource estimation functions. These applications will incorporate new and revised data and information with existing regional geologic maps and information.

Question 2: Now that 3-D seismic surveys of the GOM are marketed as speculative surveys by seismic contractors to everyone, MMS leasing policy may affect the balance of major and independent operators in the GOM. What is MMS's policy on offshore leasing of areawide tracts versus nominated tracts?

Answer: The MMS recently issued a Federal Register Notice soliciting comments on any possible modifications to current leasing policies in the GOM. The Bureau has received approximately 50 comments, which will be considered in this context, as well as that of the development of the next 5-year leasing program. While examining these comments, MMS must balance areawide leasing which allows more independents to participate in sales versus the possibility of getting more bonus revenue associated with tighter competition in tract selection sales. Innovations to 3-D seismic technology have made it easier for independents to participate in GOM sales because 3-D seismic now makes it possible to identify very small prospects. At this time, however, MMS does not anticipate significant changes in the current leasing policies utilized in the GOM leasing process.

Question 3: One trend in technology development is increased collaboration between Government and industry and within Government. Would you address collaborative efforts between MMS and other parties.

Answer: The MMS Technology Assessment and Research (TA&R) Program, which conducts oil spill prevention and response and safety research, operates through contracts to universities, private firms, and Government laboratories. The program is cooperative in nature and as such provides approximately a 4:1 funding leverage to the total TA&R budget.

Projects are conducted jointly with industry (individual companies or as part of a larger joint industry project), the American Petroleum Institute, State Governments (California State Lands Commission, California Seismic Safety Commission, Texas General Land Office, Louisiana Geological Survey), other Federal Agencies (U.S. Army Corps of Engineers, Department of Energy, National Institute of Standards and Technology, National Oceanic and Atmospheric Administration, Environmental Protection Agency, U.S. Coast Guard, U.S. Navy), as well as with our counterparts in foreign countries (United Kingdom's Health and Safety Executive, the Norwegian Petroleum Directorate, the Danish Energy Agency, Fire Research Institute of Japan, Environment Canada, and the Canadian National Energy Board). The program is also conducting joint projects with the major certification authorities (American Bureau of Shippers, Lloyds of London, and Det Norske Veritas).

The MMS is also working with industry and other Agencies on improving the recovery of oil and gas resources. For example:

The Minerals Management Service, Pacific Operators Offshore, and the California State Lands Commission Joint Carpenteria Offshore Field Study: The MMS Pacific Region, the California State Lands Commission, and the Pacific Offshore Operators, Inc., have joined to form a unique consortium in a joint technical study of the offshore Carpenteria Field. This field is located in the eastern Santa Barbara Channel and is the only field in California that straddles the State-Federal boundary with production from both the State and Federal sides. The purpose of this study is to investigate the feasibility of (1) maximizing recovery of oil from State and Federal portions and, (2) full-field unitized secondary recovery operations. Subcommittees that bring together industry and Government with a variety of disciplines are using available well and reservoir information to build both geologic framework and reservoir simulation models. A proposal for large-scale reservoir simulation modeling is under consideration by Los Alamos National Laboratory.

The Offshore Northern GOM Atlas Series: The MMS, in conjunction with the Department of Energy, entered into a cooperative agreement with the Texas Bureau of Economic Geology to prepare a

two-volume atlas series covering the central and western GOM. The Gas Research Institute is also contributing to this $4 million, 4-year project which commenced in FY 1992. The MMS is contributing significant technical manpower plus its database of geological and geophysical data and information. This atlas series will classify producing reservoirs into geologic plays, compile quantitative geologic and engineering data, and generally, tie together GOM geology. The first volume is due to be published in October 1995 and the second in October 1996.

Question 4: In your testimony, you mention that the Prince William Sound oil spill has prompted more research on oil spills. What is the state of development on in-situ burning and other oil spill technologies?

Answer: In-situ burning offers the advantages of rapid and nearly complete oil removal with fewer personnel and less equipment than mechanical response methods. The MMS has been investigating this response option for more than ten years with a focus on better understanding the resulting air emissions. This research culminated in successful cooperative burn projects at a Coast Guard facility near Mobile and offshore Newfoundland.

The full scale research burns offshore Newfoundland (August 12, 1994) involved 234 scientists, support personnel, and observers; 4 major vessels, 11 smaller vessels, 3 helicopters, 2 fixed wing aircraft, and 4 radio controlled helicopters; 4 remote control sampling boats and a remote operated submersible; and a tethered blimp.

The data from the Newfoundland burns indicate that air emissions were less than expected. All measured compounds and parameters measured at distances of more than 200m from the fire were below health concern levels . Pollutants were virtually undetectable at distances beyond 500 meters. There was no evidence of aquatic toxicity in the water beneath the burn. The small amounts of burn residue were adhesive and easily recovered.

Two Regional Response Teams (RRT's) have given pre-approval to the use of in-situ burning as a primary response option. Similar pre-approvals are being considered by other RRT's. Spilled oil has been successfully burned after incidents in Texas and Maine. At an MMS sponsored In-Situ Burning Workshop in January, 1994, the consensus of the experts in attendance was that enough information is available to propose and approve in-situ burning and that further information will serve to fine tune the decisionmaking process. The MMS is currently focusing its research on burning oil-water mixtures and further validating air emissions models.

With regard to other spill response research, MMS has participated in the development and successful flight testing of technologies to detect and quantify spilled oil in day or night conditions. Work continues with Environment Canada on the development of improved chemical treating agents. Chemical dispersants that are 5 to 10 times more effective than those currently available have been developed and are undergoing further testing. MMS is also continuing cooperative studies to better understand the fate and behavior of spilled oil.

The MMS re-opened the Ohmsett spill response test facility in New Jersey in 1992. Important boom and skimmer testing is being conducted in accordance with the standard test procedures that

have been developed. Research on innovative skimmer systems, slick detection, oil storage devices, fire boom, and other spill response equipment and strategies is planned.

Question 5: What is the MMS need for information management tools based on advances in technology?

Answer: For the MMS Offshore Program to be able to perform its mission effectively (i.e.; manage the mineral resources located on the Outer Continental Shelf in a way that ensures adequate protection for the marine and coastal environments and receives fair-market value for those minerals), MMS needs technical parity with the industry it is charged with regulating.

To accomplish this, MMS is developing and implementing the Technical Information Management System (TIMS). In addition to replacing/modernizing hardware and systems software, TIMS is building a comprehensive database to process a number of unmet needs in environmental data and analysis, operational trend analysis, oil spill risk, resource and tract evaluation, safety inspection data capture and review, hazards review, pipeline management, etc.--in other words, the full range of our Offshore mission responsibility. When completed, TIMS will have integrated a multisite, multiapplication, multidisciplined, and multiuser database into an enterprise-wide resource.

We estimate the total cost of TIMS to be approximately $68 million over 7 years; we are nearing completion of our second year. Congress has specified, through appropriations language, TIMS be developed initially as a "pilot project" in the GOM Region. The cost of the "pilot," which will be completed by the end of FY 1994, is estimated to be $15 million. The pilot includes an initial suite of Geological Interpretive Tools that will enable us to make use of 3-D seismic data and other recent technological advances in the oil and gas industry.

Question 6: I understand that the National Academy of Sciences recently completed a review of pipeline safety; does the Academy recommend any technological remedies to improve pipeline safety?

Answer: The review does not point to important new equipment and methods but does recommend the following applications of existing and developing technology:

- Existing marine pipelines should be exempt from "smart pig" requirements, but "new medium- to large-diameter pipelines . . . should be designed to accommodate smart pigs whenever reasonably practical." Operators and regulators "should continue to assess developments in smart-pigging technology and seek cost-effective opportunities for its use."

- "Pipeline operators should use a combination of leak detection methods to ensure timely detection of a broad range of leaks. Set-point limit control systems, where practical, should be used to provide quick detection of relatively large leaks. Line-balance calculations--either manual or SCADA-based [computerized Supervisory Control and Data Acquisition systems]--should be conducted at least daily, where practical, to monitor pipeline systems for small- to medium-sized leaks (which can be detected in this way with a time delay of 1 to 24 hours). Periodic visual surveillance . . . should be used to detect very small leaks and those that have gone undetected by other means. . ." The methods used would be determined by the specific operating characteristics of the pipeline system under consideration.

- Fixed mooring systems and improved communications between platforms and service vessels should be required to preclude anchor damage to pipelines near platforms. Where fixed mooring systems are impractical, platform operators should be required to provide detailed information to vessel operators concerning the configuration of local pipelines or flowlines so they may anchor in designated areas.

- Geotechnical studies of soil conditions, with sampling intervals determined by site locations, should be required as a condition of marine pipeline construction permits. The information should be later used to "develop criteria for specific gravities of marine pipelines in varying soil environments" and for periodic pipeline inspection, reburial, and abandonment requirements.

- Agencies permitting pipeline crossings of shorelines should require the use of the directional bore-installation method wherever practical.

Question 7: How does the MMS respond to new technologies, such as composite technology, within the existing inspection regulatory framework?

Answer: The objective of the MMS operating regulations is to ensure safety, protection of the environment, and conservation of resources while allowing the operator to design the drilling or production system in a way that best meets the needs of the operator. This approach enables the operator to propose designs that use the latest technology, methods, and materials when appropriate, and allows MMS to work with the operator to ensure that safety and environmental concerns are satisfied.

In some cases, the new technology may be of a nature that it does not fit within the framework of the existing regulations. In such cases, MMS regulations provide for the operator to submit a request to use new or alternate techniques, procedures, or equipment when they provide a degree of safety or environmental protection that is equal to or better than that provided for by the original regulation.

The MMS also takes a leadership role in evaluating new technology through workshops and technology assessment committees. The intent is to determine whether MMS should revise rules to enhance safety or provide for alternate technologies.

NATIONAL OCEAN INDUSTRIES ASSOCIATION
1120 G Street, N.W., Suite 900, Washington, D.C. 20005 (202) 347-6900 FAX (202) 347-8650

June 30, 1994

The Honorable Solomon P. Ortiz
Chairman
Subcommittee on Oceanography,
Gulf of Mexico and the
Outer Continental Shelf
1334 Longworth House Office Building
Washington, D.C. 20515-6230

Dear Congressman Ortiz:

Thank you for the opportunity to testify at the hearing held by the Oceanography, Gulf of Mexico and the Outer Continental Shelf subcommittee on Thursday, May 19, 1994. Additionally, I am pleased to submit responses to additional questions sent to me following that appearance.

If anyone needs further information regarding the domestic oil and gas industry, please feel free to contact the National Ocean Industries Association. We thank you for your interest and hard work on behalf of our industry.

Sincerely,

Robert E. Sleet, Jr.

Robert E. Sleet, Jr.
Vice President and Treasurer
Global Marine Inc.

Questions to Mr. Sleet from the Subcommittee on Oceanography, Gulf of Mexico and the Outer continental Shelf for the oversight hearing on the state of Research and Development in Offshore Technology:

1) *What steps can the federal government take to encourage and support the development of new technologies in the offshore industry?*

Providing access to the resource base is the most important step the government can take to encourage technological developments. Expanding and continuing moratoria serves as a disincentive to invest dollars into research and development programs. It is also important for industry to have some certainty that the regulatory programs will remain consistent in their application without increased burden. In addition, the government can use the royalty program, the tax code and lowering the cost of regulatory compliance to encourage industry.

2) *Are there any ongoing or planned partnering initiatives with foreign companies regarding technology development?*

Given the global nature of the industry I am certain that partnerships are ongoing with foreign companies. Although, NOIA does not represent international interests, we understand some member companies have been involved with such partnerships. If you require further information, we can ask them to be in contact with you.

3) *What are the foreign governments doing to encourage offshore oil and gas technology development?*

In most cases the oil and gas industry in foreign countries is a key source of hard currency and key component GDP because of the export and sale of its products. As a consequence, foreign governments typically utilize the tax code to attract exploration and stimulate development and production of oil and gas.

4) *Subsalt exploration and production technology is very expensive, is it readily available to independent operators in the Gulf?*

To date, exploration in the subsalt region has been in deeper water in an area usually ventured only by larger independent or major oil companies because of the related expense. The subsalt prospects have also been exploratory wells with higher risks than many independent operators are willing to undertake. As the subsalt play has more history, it is probable the area of interest will be extended to shallow water where costs will be more in line with budgets of smaller independent operators.

5) *Can existing infrastructure within the Gulf maintain the development of potential subsalt reserves?*

Subsalt exploration currently in progress is taking place on the shelf, where existing infrastructure is abundant. If development of the subsalt area occurs, pipelines will have to be built from the area to tie in with the existing infrastructure. Physical resources are currently available to develop the reserves.

6) *What are other applications of three dimensional seismic surveys that may be implemented throughout the oil and gas industry? One example that comes to mind is surface survey for pipeline laying?*

While I am not aware of any use of three-dimensional seismic surveys for pipeline

laying, because of the unnecessary expense for doing so, there are instances where high resolution surveys are conducted for platform locations. The primary uses of 3-D are to resurvey mature area in search of new fields, to more accurately detect locations and sizes of reservoirs in newly explored areas, to monitor the progress of enhanced oil recovery processes and for environmental studies, such as to detect groundwater locations.

7) Is there a potential to use new technologies from onshore operations in the offshore operations?

Yes, horizontal, or slant, drilling is an excellent example of this. Most technologies used by industry are feasible and adaptable for both onshore and offshore uses.

8) Implementation of new technology in the Gulf of Mexico has increased operations for the offshore industry. What changes have there been in the numbers of personnel working in the Gulf and what impact has that had on onshore numbers?

NOIA does not maintain data to accurately state the influence of the implementation of new technology on jobs, but, as is stated on page four of my testimony, every $1 million invested in an offshore project creates 20 jobs. And, for every 10 jobs created offshore, 37 are created onshore.

9) Can the recently introduced new technologies in seismic surveys and subsalt prospecting maintain the renewed interest in the Gulf of Mexico long enough for further developments in domestic deepwater drilling to be introduced?

The potential of subsalt production can be expected to sustain a high level of interest in parts of the Gulf of Mexico while further exploration and delineation takes place. Additional deepwater development will be determined by the economics of each project.

10) You mentioned that deepwater areas had previously been open only to the larger companies because of the risk and high capital costs. Can you give an overview of developments taking place in reducing the risk and costs of exploration and production that are opening the deepwater areas to smaller companies?

The primary deterrent to smaller companies for participating in deepwater areas is the cost/benefit ratio of exploring for hydrocarbons; costs are much higher due to additional size type and quantity necessary for deepwater operations. In such cases there are no real economics of scale. On the other hand, three dimensional seismic technology has allowed the operator a higher degree of accuracy in determining the location of hydrocarbons. The high costs of deepwater projects is due some part to the lack of pipeline infrastructure. As this infrastructure is built, the cost of future projects is likely to decrease, making it more feasible for smaller fields to be developed and for smaller companies to invest in deepwater projects.

11) What type of economic assistance would be necessary, in your opinion, to insure the potential benefits of the deepwater Gulf of Mexico are fully realized?

Any combination of increased access and use of the royalty program, tax code and reducing the costs of regulatory compliance that would result in improved economics will help ensure that the benefits of the Gulf of Mexico are fully realized.

12) On page three of your testimony, you give figures for the potential revenues to be gained from the deepwater Gulf of Mexico. What dollar per barrel of oil and dollar per million cubic feet of gas did

you use in your calculations?

The dollar amount is $20 per barrel of oil equivalent using 1990 dollars in 2010.

13) *Now that three dimensional seismic surveys have replaced the conventional two dimensional seismic surveys, what legislative or regulatory support does the oil and gas industry need to maintain the current renewed interest in the Gulf of Mexico?*

Three dimensional seismic surveys (3-D) have not completely replaced the more conventional two dimensional seismic surveys, but 3-D does offer the oil and gas operator a greater chance to pinpoint the location of hydrocarbon before the well is drilled.

14) *When industry develops and implements new technology that may have implications for MMS regulatory responsibility, for example the use of new composites and MMS's inspection program, how do MMS and the operators accommodate these new developments? Can these changes be accommodated within the existing inspection regulatory framework?*

I am not aware of any new technologies on the horizon that would require a change in the regulatory framework at MMS.

PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA 74004 918 661-6600

EXPLORATION AND PRODUCTION GROUP

June 30, 1994

The Honorable Solomon P. Ortiz
Chairman, Subcommittee on Oceanography,
Gulf of Mexico, and the Outer Continental Shelf
U.S. House of Representatives
Room 1334, Longworth House Office Building
Washington, D.C. 20515-6230

Dear Mr. Ortiz:

Enclosed please find the answers to the additional questions posed based on my testimony of May 19, 1994. It is our pleasure to assist our government in the review of legislation that impacts the use of technology in the oil industry. If we can be of any further assistance, please do not hesitate to contact either myself, or Don Duncan or Linda Davidson (202-833-0907 or 202-833-0914, respectively) in our Washington, D.C. office.

With kindest regards,

James F. Fox
Geoscience Director
918-661-0145

JFF/gj

Enclosure

Questions to Mr. Fox from the Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf for the oversight hearing on the State of Research and Development in Offshore Technology:

1) **Would you tell us about the complexities of drilling in salt tables and how these difficulties might be addressed in new technology?**

Drilling through salt is difficult due to the fact that salt can be dissolved away very quickly by typical drilling fluids (called muds by the industry). We typically use a water-based "mud" to drill Gulf Coast wells, due to the adverse environmental impact of using oil-based muds. To balance these two concerns, we must first use a typical water-based mud in drilling the sediment above the salt; then, change to a super-saturated "salt" mud to drill through the salt; then finally, change back to a water-based mud to drill the subsalt section.

We are looking to use new muds to drill through the salt; muds that have the operating characteristics of oil-based muds, but are water-based polymers that don't harm the environment. Unfortunately, the current cost of these muds are prohibitive when used to drill through thousands of feet of salt. Hopefully, new advances in this area will make these types of muds more affordable in the future.

A more important drilling problem is encountered below the salt. Due to the extreme pressures in the deep subsurface, our drilling engineers must carefully "balance" the density of the mud to not only3 maintain a safe drilling operation, but also yield good results by not damaging the rock so that we can produce the hydrocarbons later. This challenge is being met by using sensitive measuring instruments located down hole at the drill bit, and constantly using additives in the drilling mud to make the density balance dynamic.

2) **Subsalt exploration and production technology is very expensive, is it readily available to independent operators in the Gulf?**

Subsalt exploration and production technology is expensive, but we are seeing several independents very active in the play. Our main partner in the Gulf of Mexico is Anadarko. They access the technology by their alliance with us, and by using contractors who are now offering similar technology. Most other independents that are actively pursuing this play use a similar strategy; partnering with a major to lower their financial exposure and risk. As the technology proves its value, seismic contractors develop their version of the technology and make it available to the rest of the industry.

3) **Can existing infrastructure within the Gulf maintain the development of potential subsalt reserves.**

Existing infrastructure within the Gulf is sufficient to develop several subsalt fields. However, if a giant field is discovered, or there is a significant increase in drilling operations, there will probably be a shortfall of drilling equipment and personnel. As in the past, though, the oil industry can usually react to these demands in a fairly short time period by allocating resources worldwide.

4) **In your testimony, you mention that salt domes are found worldwide. Do salt domes occur anywhere else to the extent that they are found in the Gulf of Mexico?**

Salt domes are located in basins where a large quantity of salt was deposited in the past. Other salt basins that have salt domes with large associated oil fields are located in the North Sea of Europe, offshore Brazil, offshore Gabon and Congo, offshore Mexico, and onshore Russia and Iran. The most prolific producing basins are the North Sea and Mexico, but neither basin has the amount of salt bodies compared to the Gulf of Mexico.

5) **Is horizontal drilling technology sufficiently advanced to make subsalt prospecting economically and environmentally efficient?**

We have not attempted to use horizontal drilling technology in the subsalt, and at the present do not think that we will need to use it, due to the high deliverability of the sands that we have tested to date.

6) **What are other applications of three dimensional seismic surveys that may be implemented throughout the oil and gas industry?**

Three dimensional seismic surveys are heavily utilized by the oil and gas industry, both onshore and offshore by major and independent. This technology is reaching its maturity, and is probably the leading technology used to lower risk by the industry.

7) **There have been many advances on offshore technology recently. Are you experiencing economic benefits sufficient to maintain a focus on developing new technologies?**

Phillips supports a very active research and development group to economically apply the latest technologies. However, with the continuing trend of low oil prices, we must constantly be focussing on key technologies that yield a short term benefit. This focus on the short term limits one's ability to truly develop new technologies, but rather focusses on finding new applications of existing technologies.

8) Are there any ongoing or planned partnering initiatives with foreign companies regarding technology developments?

Phillips is an international oil company, and has partnerships with many other international oil companies and state-owned oil companies. This association means that we are involved with numerous foreign companies in technology development, with key research in Europe being a major part of our research and development effort.

9) What steps can the federal government take to encourage and support the development of new technologies in the offshore industry?

The federal government can encourage and support the development of new technologies by continuing to support university research, forming alliances with key government labs and industry research groups, and by providing favorable tax status for investment in research.

10) What, to your knowledge, are foreign governments doing to encourage offshore oil and gas technology development?

Foreign governments are supporting offshore oil and gas technology development in similar ways as the U.S. We know of strong support in the UK and Norway of research programs related to three dimensional seismic acquisition, geology of offshore basins, deepwater drilling and production, and other related topics. As the price of oil continues to stay low, and more countries are trying to encourage foreign investment in oil and gas, there will be strong competition for the limited capital and expertise that the oil industry has available. Only the countries that provide good value, potential and support will continue to attract oil and gas investments.

11) Can the recently introduced new technologies in seismic surveys and subsalt prospecting maintain the renewed interest in the Gulf of Mexico long enough for further developments in domestic deepwater drilling to be introduced?

The subsalt play is a new play, and relatively untested. It is too early to determine if the size of reserves will be sufficient to warrant the size of investment necessary to fully develop it, so it is difficult to quantify the impact on the industry in the Gulf of Mexico. At the present, Phillips is optimistic that the potential rewards make the risks we face worthwhile.

12) Now that three dimensional seismic surveys have replaced the conventional two dimensional seismic surveys, what legislative or regulatory support does the oil and gas industry need to maintain the current renewed interest in the Gulf of Mexico?

Phillips believes that the present system of leasing in the Gulf of Mexico is sufficient to maintain the current interest. One additional support would be to lengthen the primary risk term from the current five year period. Due to the time it takes to depth migrate the three-dimensional seismic data, and the much greater than average time to drill and test subsalt wells, it would be advantageous to have a longer license period to fully evaluate the block potential.

13) When industry develops and implements new technology that may have implications for MMS regulatory responsibility, for example the use of new composites and MMS's inspection program, how do MMS and the operators accommodate these new developments? Can these changes be accommodated within the existing inspection regulatory framework?

Phillips has had a very good working relationship with the MMS, and anticipates any future changes can be handled sufficiently under the existing framework.

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